

PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

NATIONAL PARK SERVICE
U.S. DEPARTMENT OF THE INTERIOR

VOLUME 8 - NUMBER 2

WINTER 1988



ARTICLES

- Shenandoah National Park Adopts New Fisheries Management Policy 3
- Vegetation Monitoring of a Subalpine Oil Spill 4
- Predicting Gypsy Moth Defoliation Patterns in Shenandoah National Park 5
- Smokies Study Visitor Communication 6
- Water Purification for *Giardia*: What Works in the Backcountry? 7
- Fourth World Wilderness Congress Links Protection and Development 8
- Acid Rain Experts Find No Simple 'Cause and Effect' 8
- Water Quality Workshop Held at Olympic NP ... 15
- Joint US-USSR Research Proposed for Beringian Sites 16
- Ecological Studies of Sunken Forests 17
- Task Force Coordinating Science Pubs 17
- Oral Bait Acceptance Research in D.C.'s Rock Creek Park 19
- Ecosystem Management for Parks and Wilderness Report of the Workshop 20
- Improving the Role of Science in the National Park Service 22
- Long-term Research Symposium Summary 23

Departments

- MAB Notes 9
- Meetings of Interest 10
- Information Crossfile 11
- Regional Highlights 13
- Letters 16
- Superintendent's Corner: Strategic Management Needed to Maximize Park Resources 18
- Geographic Information 21

Miscellaneous

- Acid Dew Possible Factor in Tree Leaf Damage 9
- Natural Areas Association Boasts Record Attendance at Annual Meeting 10
- Interpreters Form New Organization 10
- Restoring the Earth 10
- European Forest Decline Sparks Tree Death Interest 12
- Archeological Research Bares Prehistoric Past 16

Editorial

The opening of a new dimension in *Park Science's* coverage of scientific research and its management applications in the National Park System began with the addition of Historical Research notes in the Fall issue (Vol. 8 No. 1). Ed Bearss, NPS Chief Historian, kicked it off with the question "Can NPS professionals who focus on the human past be more useful to scientists and vice versa? Can the two disciplines, with better coordination, increase their value to management?"

Bearss went on to describe several fascinating areas of historical research – areas with promise of rich rewards for resource managers and interpreters (see p. 17, Fall *Park Science*).

The new avenues of communication opened by this connection have forced the editorial board to address the question of how best to handle the wealth of new material this development makes available. As we said in the fall editorial column, we expect this addition to bring more texture and depth to this quarterly reflection of our evolving research and management process. But in order to keep to our primary commitment – the timely transmission, systemwide, of on-going research and management issues – we will limit historical and cultural coverage to research. Peripheral activities that often are of intense interest but not strictly science-related will be briefly described in the Historical Research notes and in many cases will be carried in fuller detail in the George Wright Society FORUM.

Such is the case with the recent exchange trips between the United States and USSR park teams. Bill Brown, NPS historian based in the Alaska Region, was designated by the U.S. team to write his impressions of the USSR scene as it was experienced during the U.S. team's October visit to the Soviet Union. Brown's paper will appear in Vol. V No. 4 of the George Wright Society FORUM in Spring 1988.

On the other hand, *Park Science* will report in some detail on the scientific protocols that are emerging from that exchange. (See page 16 this issue.) Other eagerly awaited items stemming from this new historic facet to *Park Science* include results of the two year study recently begun in the North Atlantic Region of genetic resources of historically significant fruit trees in the National Park System. This study, being carried out by the UMass, will produce a computer-based inventory of historic orchards in the System, identify and collect specimens of any unique genetic material found, and recommend management actions to conserve and propagate such material. The NPS concern for conservation of historic landscapes makes this study entirely appropriate to the *Park Science* networking effort.

With these evolving guidelines in mind, *Park Science* welcomes any and all news from its readers about research and/or management news in the areas of historic and cultural activities.

Regional Chief Scientists

Anderson, William H.
NATIONAL CAPITAL REGION
1100 Ohio Drive, S.W.
Washington, D.C. 20242
8(202)342-1443

Dottavio, Dominic
SOUTHEAST REGION
75 Spring St. S.W.
Atlanta, GA 30303
8-242-4916 (404) 221-4916

Karish, John R.
MID ATLANTIC REGION
Ferguson Bldg, Room 209-B
Pennsylvania State University
University Park, PA 16802
8(814)865-7974

Kilgore, Bruce
WESTERN REGION
450 Golden Gate Ave.
P.O. Box 36063
San Francisco, CA 94102
8-556-4968 (415) 556-4968

Ruggiero, Michael
MIDWEST REGION
1709 Jackson St.
Omaha, NE 68102
8-864-3438 (402) 221-3438

Huff, Dan
ROCKY MOUNTAIN REGION
P.O. Box 25827
Denver, CO 80225
8-327-2650 (303) 969-2650

Larson, James W.
PACIFIC NORTHWEST REGION
83 S. King St., Suite 212
Seattle, WA 98104
8-399-4176 (206) 442-4176

Soukup, Michael
NORTH ATLANTIC REGION
15 State Street
Boston, MA 02109
8-835-8805 (617) 565-8805

Fletcher, Milford
SOUTHWEST REGION
P.O. Box 728
Santa Fe, NM 87501
8-476-6412 (505) 988-6412

Lovaas, Allan L.
ALASKA REGION
2525 Gambell St., Room 107
Anchorage, AK 99503-2892
8 (907) 271-2612

Please address requests for information to appropriate Regional Chief Scientist.

Shenandoah National Park Adopts New Fisheries Management Policy

By David A. Haskell

In 1936, when Shenandoah National Park was established, only a handful of the better trout streams still contained populations of native brook trout. The stripping of the forest cover, heavy grazing, frequent wild fires, and subsequent soil erosion had put an end to the centuries old Appalachian strains of brook trout, which had evolved in many of the small headwater mountain streams. However, protected within the boundaries of the new National Park, the forests, watersheds, and streams began to recover.

During the early years of Park management, the CCC's and later Park maintenance crews, gave nature a helping hand by constructing erosion control devices to help hold the remaining soil in the areas where damage was most severe. By the early 1950s most of the Park streams were capable of supporting brook trout once again. Unfortunately, during the mid-1950s a severe drought caused many of the newly-recovered streams to go nearly dry.

The U.S. Fish and Wildlife Service (USFWS) was working with the National Park Service (NPS) at that time in an effort to assess the condition of the Park's trout streams. Following the drought, all of the stable Park streams that did not contain native trout were stocked with fish taken from other Park streams or with young native brook trout taken from streams in the Great Smoky Mountains NP. Most of the trout from the Smokies did not survive; however, the fish taken from local streams did well.

In the earlier years of the Park, although few anglers were interested in fishing for the rather small native trout, the newly-recovered streams were recognized as a valuable resource. A set of regulations was adopted which would serve to protect these new populations from excessive harvest. Fishing with bait was prohibited; all Park streams are open to fishing; a five fish limit was imposed, and all fish under eight inches had to be released. The fishing season was set so that it ended before the fall spawning season (late October), thus protecting spawning trout. The Park Superintendent was given authority to close a stream

to angling should the trout be seriously threatened.

In the early 1960s, two streams were selected to be managed as catch and release (locally known as fish-for-fun) streams. These streams have become increasingly popular because of the larger-sized fish and the year-round season. From the late 1950s until the early 1980s, stream habitat in the Park continued to improve and the native brook trout flourished.

Even though the South is best noted for its warm water fishing, more and more anglers began to discover the thrill of fishing for these feisty little trout in the Park's clear mountain streams. Today hundreds of anglers regularly fish the 30 major Park trout streams and thousands of 8- to 11-inch brook trout are harvested each year.

In an effort to assess the impact of angling and other "anthropogenic perturbations" on native trout (don't ya love those \$100 words?), an intensive monitoring program was initiated in 1982. The initial phase of this work was to evaluate the intensity of the suspected impacts, so that an appropriate long-term monitoring strategy could be developed. The results of the first year's evaluation showed that some Park streams were being subjected to severe impacts from poaching, heavy angling pressure, and acid deposition, along with natural influences such as drought and flood. Data collected between 1983 and 1986 substantiated this initial finding and further quantified the impacts. It was determined that a Fisheries Management Plan was needed to specify what management, monitoring, and research projects were needed to properly protect and manage the Park's fisheries resources and aquatic ecosystems.

The Park's first Fisheries Management Plan was approved in June 1987. The plan describes two major changes in management philosophy that have significantly increased the Park's ability to properly manage these resources. They are: (1) brook trout are an integral part of the aquatic ecosystem and have a value that exceeds their contribution to angler harvest; and (2) fishing will only be permitted in those Park streams for which monitoring data clearly show that the trout population can withstand the impact without

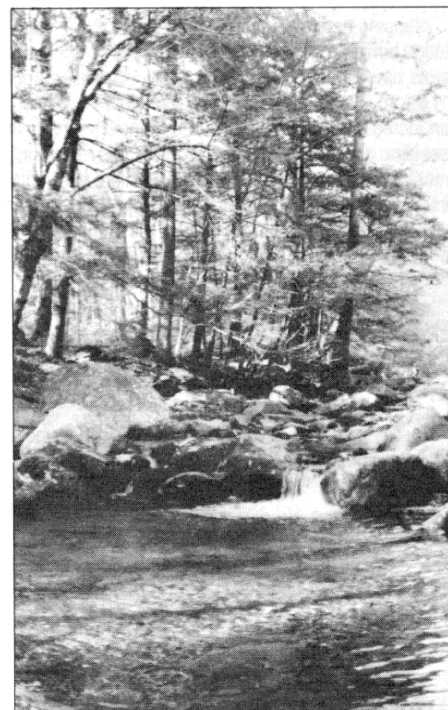
significantly altering the function of the aquatic ecosystem.

These are viewed by some as somewhat radical ideas. However, they are rooted deep in long-standing NPS tradition and policy. For most National Parks, the only living things (other than some fruits and berries) that can be killed or removed are fish. Since the Service is charged with the protection of wildlife and the function of ecosystems in general, one would question why fish can be harvested at the same time that all other natural resources are so diligently protected. This question is not brought up to start controversy, but simply to point out the underlying factors that shaped the development of the Park's Fisheries Management Plan.

Revised fishing regulations were published in the Federal Register in October 1986 and approved by the Department of Interior in May 1987. Major changes from the old regulations include: (1) all Park streams are closed to fishing except those listed as open in the Park's Fisheries Management Plan (a list that is subject to change each year); (2) the North Fork Moorman's River was added to the fish-for-fun program making a total of three catch and release streams; and (3) species of game fish other than trout may also be harvested in accordance with state law.

Development of the Fisheries Management Plan, the annual trout population monitoring program, and the changes in the fishing regulations have resulted in a clearer understanding of the Park fisheries resources and have led to a more responsive and effective management program. Some difficult problems remain to solve, but the Park staff now has the tools available to better address these issues.

Haskell is a Resource Management Specialist at Shenandoah National Park.



Native brook trout like the one shown here now flourish in 30 major trout streams that run through Shenandoah NP. The stream on the right is typical of the setting in which hundreds of anglers harvest thousands of brook trout each year.

Vegetation Monitoring of a Subalpine Oil Spill

By Regina M. Rochefort and Mignonne M. Bivin

During the winter of 1985, an underground storage tank leaked in Mount Rainier NP, losing approximately 9,600 gallons of diesel fuel. The oil seeped out over a period of several months moving under snow or through soil into a subalpine meadow approximately one-third of a mile from the tank site. Following the July 1985 discovery of the pooled oil, site clean-up and monitoring of water quality and vegetation were initiated (Park Science, Cat Hawkins article, Spring 1986, pp. 20-23).

The major area of oil accumulation, approximately 9/10ths of an acre, was a subalpine meadow at 5400' elevation. This area gradually slopes from west to east with a small creek descending from the eastern end. The center of the area is depressed with a wet sedge vegetation type dominated by *Carex spectabilis*, *C. nigricans*, *C. lenticularis*, *Aster alpigenus*. The north and south edges are slightly elevated and are dominated by a mosaic of heath-shrub and low herbaceous communities.

Vegetation Monitoring

Vegetation monitoring began in August 1985 and consisted of establishing a grid system over the affected area (15 meter intervals), mapping the top-killed and live vegetation, and establishing one square meter vegetation plots systematically throughout the area. Within each vegetation plot percent cover is recorded for live vegetation, top-killed vegetation, bare ground, standing water, and individual species; density also is recorded for herbs and sedges. Percent cover was calculated using Daubenmire's canopy cover classes of < 1%, 1-5%, 6-25%, 26-50%, 51-75%, 76-95%, and 96-100%. Top-killed vegetation was recorded instead of dead vegetation because during the first year it was difficult to determine which plants were dead without digging up the roots. Mapping has been done annually and vegetation plots biannually since 1985.

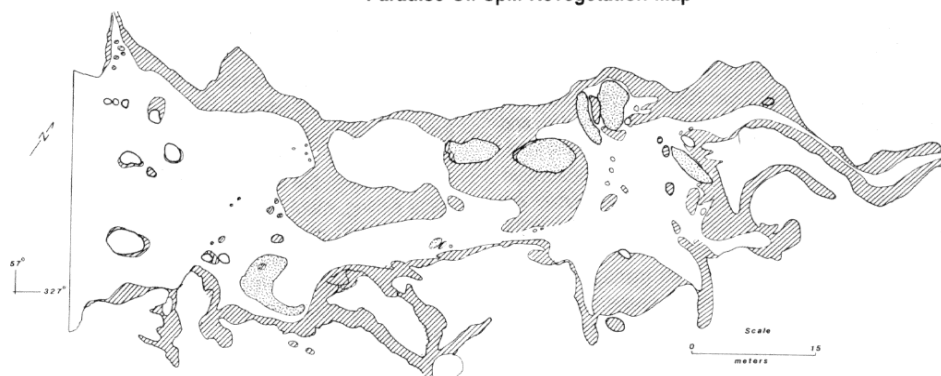
Mapping has revealed a 53% increase in live vegetation between August 1985 and July 1987. Vegetation plots have shown an increase in live vegetation from 11.8% to 23.1%, a decrease in top-killed vegetation, an increase in bareground, and a marked increase in seedling densities (see Table 1). The areas recovering most quickly are the lower areas, which are frequently inundated by running water. This finding is consistent with the findings of Belsky (1982) in monitoring a 1972 oil spill at 5,000' near Mt. Baker, Wash. She explains that ground water in these areas initially prevents infiltration of oil into the soil and later continues to flush it out, thus enhancing plant growth and seedling establishment.

Importance values calculated each year revealed the same three dominant species: *Carex spectabilis*, *Aster alpigenus*, *Carex nigricans* having distinctly higher values than other species. Seedling densities also were highest for these three species with a fourth species (*Agrostis sp*) appearing in the October 1986 survey and increasing slightly in the 1987 survey. A survey of adjacent, undisturbed areas is still needed to compare their composition with those of the disturbed site.

Resource Management Implications

In addition to the vegetation monitoring initiated in 1985, 10 plots were established in that year to test management alternatives. Four plots were planted with greenhouse grown *Carex nigricans* plants (19 per

Paradise Oil Spill Revegetation Map



□ Areas of top killed vegetation

▨ Areas of standing water

▩ Areas revegetated by July 9, 1987

plot), two plots were seeded with *Carex spectabilis*, two plots were raked of dead debris and seeded with *Carex spectabilis* seeds, and two plots were just raked. All plots were one square meter in size and seeded plots were seeded with equal volumes of seeds. All seeds were collected in the immediate area and all greenhouse plants were propagated from local stock.

Management plots were monitored in 1986 and 1987. Ninety-five percent of all greenhouse plugs have survived. Approximately 35% have produced seeds, but none appeared to have increased in size. Of the remaining treatments, seedling densities are higher in the "rake and seed" plots than in either the "seed only" or "rake only" plots (2986 vs. 805 and 601 respectively).

Based on the vegetation mapping and monitoring plots, the area seems to be recovering rapidly on its

own and no revegetation efforts are recommended at this time. However, the western edge of the site is slightly higher and drier than the rest of the area and has shown very little plant recovery. If this section does not show some recovery over the next two summers management actions may be considered. In that case, seeding and raking appears to be the quickest and most successful revegetation technique.

Rochefort is a Botanist and Bivin is a Biological Technician at Mount Rainier NP.

Literature Cited

- Belsky, Joy. 1982. Diesel oil spill in a subalpine meadow: 9 years of recovery. *Canadian Journal of Botany*, 60:906-910.
Hawkins, Cat. 1986. Parks Need to Gear Up for 'Can't Happen Here Crisis.' *Park Science* 6(3):20-23.

Table 1. Summary of Vegetation Plot Data

Cover class	Percent Cover			
	8/85	7/86	10/86	7/87
Bareground	5.2	10.5	24.8	14.9
Top-killed	84.8	71.3	63.1	47.7
Live	11.8	16.5	11.1	23.1
Stream	6.0	6.0	6.0	6.0
Total Plant Densities per Sampling Period				
herbs and sedges	570	416	2416	3643
number of species within study plots	12	19	17	20

Predicting Gypsy Moth Defoliation Patterns in Shenandoah National Park

By David Haskell and Alison Teetor

It's not often that major disruptions to Park ecosystems occur. Usually they are associated with volcanic eruptions, floods, hurricanes, or catastrophic wildfire. However, in the case of Shenandoah National Park (SNP) the currently expected change will be brought about not by a natural cataclysm but by a lowly caterpillar.

Gypsy moths have become the most serious and devastating forest pest in the Mid-Atlantic area of the Eastern Seaboard. Accidentally introduced into Massachusetts in 1860, the alien forest pest has been spreading south and west for the past 120 years. This defoliator prefers oaks, and the forests of Pennsylvania, Maryland, Virginia, and West Virginia have a much higher percentage of oaks than do northern forests. As the insect moves south, the increase in preferred habitat has caused the rate and intensity of defoliation to increase dramatically. Repeated defoliation not only leads to high rates of tree mortality but greatly reduces the production of hard mast such as acorns and hickory nuts, so important to the winter survival of many wildlife species.

The forests of SNP are dominated by oaks, many of the ridge-line to mid-slope areas being over 80 percent oak. Trees on the higher elevation ridges are damaged repeatedly by severe winter ice storms. Poor soils in other areas place additional natural stresses on the trees. Because of all this, the SNP staff has become increasingly concerned about the potential impact this alien invader could have on the park.

Methods

Gypsy moths were first discovered in the park in 1984. To guide future management actions, a Gypsy Moth Management Plan was devised, calling for development of a defoliation hazard rating system, or map, that would delineate high risk areas. This was considered essential in order to assess this insect's potential impact on park operations, visitor use areas, wildlife, forest ecosystems, and adjacent landowners.

The first phase was to determine the park's forest cover types. A forest cover-type map based on color infrared photography was completed in 1987 (article by Teetor, *Park Science*, Spring 1987). This map became one of the first major components of the park's new Geographic Information System (GIS). Since factors other than tree species affect the likelihood that a given area will be defoliated, a literature review was conducted under NPS contract by Shumway and Bowersox, 1987. The review indicated that very little definitive work had been accomplished on this topic. The most promising systems used in the past to determine stand susceptibility were those developed by Houston and Valentine, 1977 and Herrick and Gansner, 1986. Both systems used two major factors, the percent of oak in the stand and the ability of the stand to provide larva hiding and resting places, e.g. broken branches, knot holes, hollows, etc., caused by fire, ice damage, or other disturbances.

Although not yet documented, it is believed that the upper half of ridges provides climatic conditions more favorable to gypsy moth survival and spread. These areas have good air movement and lower humidity, which seems to reduce larval susceptibility to disease.

Strong spring winds aid the rapid spread of the young larva.

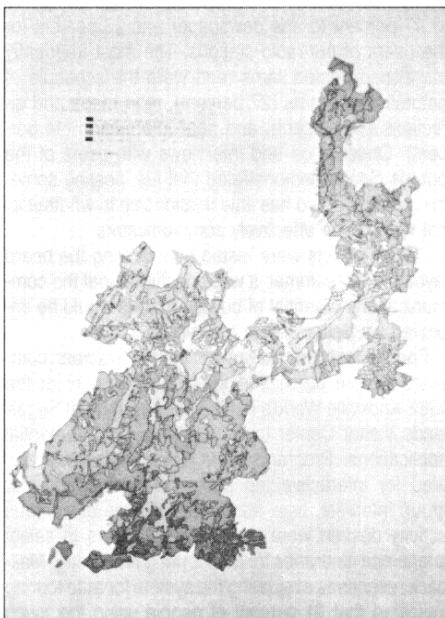
Based on this information, we chose to base our forest susceptibility map on two primary factors: (1) *the forest type classification*, i.e., percentage of preferred or non-preferred species, and (2) *the degree of known tree stress* due to ice damage, human development, severe fire and soil conditions. The relative values for the ice damage and soil conditions are expressed as elevation. High elevation ridges in the park receive severe ice damage and also quite often have poor, quickly draining soils subject to the effects of drought. The major developed areas, which contain a high percentage of preferred host tree species, were assigned a high risk rating because of tree stresses due to pavement, soil compaction, and damage caused by campers. These areas also are more susceptible because of the movement of RVs, which could transport gypsy moths into the developed area from other infested areas.

Susceptibility classes were divided into four groups; very high, high, moderate, and low. The parameters of each class are as follows:

Very high: chestnut oak stands > 2000 feet elevation and all developed areas with forest types of chestnut oak, red oak, or red oak/ash/basswood.

High: chestnut oak stands < 2000 feet elevation, red oak stands > 2800 feet elevation.

Moderate: red oak stands < 2800 feet elevation, red oak/ash/basswood stands > 2800 feet elevation.



This GIS plotter product represents the North District of Shenandoah NP in four colors – red, orange, yellow and green – denoting very high, high, moderate, and low susceptibility to Gypsy moth infestation. The GIS plotter also can show the same information in black and white by using a variety of shadings, hatchings, etc., and provides an at-a-glance picture of insect hazards to the park.

Low: red oak/ash/basswood stands < 2800 feet elevation, black locust stands any elevation, pine stands any elevation, poplar stands any elevation.

Mapping of these classes was started using the northern most district as a test area. The two factors for each susceptibility class were combined on the park GIS. Since the forest types were in polygon format and the elevation data in cellular format, we had to convert our forest stand GIS theme to cellular format in order to combine the two themes. This was accomplished with the assistance of the GIS Division in Denver. The final product was a scale map of the park in the four colors chosen to represent the susceptibility classes. Major roads and developed areas were added to provide reference points. North District acreage values generated by the computer were: very high = 10,305, high = 15,386, moderate = 10,804, and low = 17,543.

Conclusions

This method of predicting susceptibility of forests to gypsy moth defoliation is based on information currently available. The system's validity will be determined over the next several years as areas actually defoliated are entered in the GIS and overlays compared. By the time the infestation has moved through the North District, we should have determined the accuracy of the new susceptibility map. Since our data bases are on a GIS, corrections or modifications to the system can be easily made.

The next phase in determining the impact of gypsy moths on the park is to assess actual tree mortality levels as this relates to stand type. Not all trees defoliated by gypsy moth larva will die; however, there are some factors known to affect mortality and other factors suspected of playing a role. Since both defoliation and tree mortality affect ecosystem dynamics, the study of both factors will be necessary before we can obtain a clear picture as to the degree of gypsy moth impact on park resources and the visitors enjoyment of them.

Literature Cited

- Herrick, O.W., and D.P. Gansner, 1986. Rating forest stands for gypsy moth defoliation. USDA For. Ser. Res. Pap. NE-538.
- Houston, D.R.; and H.T. Valentine, 1977. Comparing and predicting forest stand susceptibility to gypsy moth. Can. J. For. Res. 7: 447-461.
- Shumway, D.L., and T.W. Bowersox, 1987. Gypsy moth risk assessment for Shenandoah National Park. NPS-unpublished report.
- Teetor, A., 1987. Using 35mm color infrared slides to map vegetation. Park Science, Volume 7, N-3.

Smokies Study Visitor Communication

By John Peine, Chief

Great Smoky Mountains NP Science Div.

Why should a national park manager be vitally interested in communications with visitors? Because it is the primary means of managing visitor behavior short of implementing use restrictions or altering the infrastructure of facilities available.

Effective communication between manager and visitor enhances every phase of park operations, from maintenance and law enforcement to interpretation and resources management. It is important for park management to develop an overall communications strategy: understand the behavior and attitude of target audiences and decide how various media can best contribute to the efficient conveyance of a clear set of priority messages. For the past five years, the social science research program at Great Smoky Mountains NP (GRSM) has focused on various aspects of communications in order to improve the people aspects of park management.

A three-year study begun in 1982, conducted by John Peine, Craig Walker, and Paul Mott, focused on the effectiveness of a variety of media commonly used to communicate with park visitors. As a first step, park managers and personnel directly in contact with the public were interviewed concerning their opinions on the priority of messages and how effectively they are conveyed to visitors. Later, visitors were asked to define the kinds of information most important to them during their park visit. The managers and visitors had markedly different message priorities; i.e., rules and regulations versus orientation. Communications is defined by Webster as "a process by which means are exchanged between individuals." The sender must convey messages in terms that are of interest to the receiver. This fundamental principle is all too often ignored.

The park newspaper is the primary vehicle available to managers to convey detailed information to visitors. No other medium generated at the park level has as great a potential to affect behavior patterns. It is the voice of the superintendent in the park. Only 39 percent of the visitors queried in the 1983 general media questionnaire were aware that a newspaper exists. Only 11 percent of them used it. Even 40 percent of those who stopped at a visitor center where the paper is distributed were unaware of its existence. Only three percent of the visitors surveyed attended an interpretive program after reading about it in the paper, but 48 percent of those who read the paper and knew it contained an interpretive program attended one based on reading about it. Similarly, 42 percent of those who read the front page article did something based on what they had read. These findings suggest that the paper, if it is read, can affect visitor behavior. It was concluded that the newspaper needed better marketing and improved design.

The park radio system has the potential to reach a greater percentage of park visitors than any other medium available to park management. The radio provides a means to penetrate the sanctity of the visitor's private environment where most of the park visit is likely to take place: inside the private vehicle. Although 75 percent of the respondents indicated they were aware of the park radio stations, only 26 percent of them had listened to it. Several groups were more likely to be aware of the radio stations than their counterparts: those who stopped at visitor centers, stayed longer in the park, and were campers. Stations at the two main entry points to the park (Sugarlands and

Oconaluftee) received the most use. Of those questioned, 72 percent were unaware there were different radio messages throughout the park. The visitors who wanted most to hear interpretive messages from the radio accounted for 61 percent of those questioned. Only six percent of the total surveyed decided to do something based on a radio message heard, but this represented 23 percent of those who had listened to a radio message. This indicates that radio can affect behavior once it has gained visitor attention.

The radio message was changed at one station in mid-summer to see if the application of principles of radio advertising would increase retention of the message and therefore have a greater influence on behavior. The retention of the message was significantly greater, but the test for the effect on behavior was inconclusive. It was suggested that the radio system needs better marketing, with the messages shortened, simplified, and made more interesting.

The often neglected bulletin board can be a powerful communications tool. More visitors are likely to look at bulletin boards than to stop at a visitor center or listen to a radio message. Locations are more widely distributed throughout the park. Bulletin boards are usable 24 hours a day; visitors can communicate with one another via a message board.

Two-thirds of the visitors were aware that the park had bulletin boards at various places. That represented more awareness than for the newspaper (39 percent) but less than for the radio (75 percent). More people looked at the bulletin board (54 percent) than listened to the radio (26 percent) or read the newspaper (11 percent).

Of the respondents who looked at park bulletin boards, 22 percent indicated that they had used some of the information. This proportion of use compares to 47 percent for the newspaper and 23 percent for the users of the radio stations. The most frequently mentioned posted items read were the schedule of naturalist programs (27 percent), road maps and directions (14 percent), and bear information (14 percent). Observation and interviews with users of the boards clearly demonstrated that just posting something on the board has little relationship to whether or not it has been effectively communicated.

Design effects were tested by changing the board layout in mid-summer. It was concluded that the communications potential of bulletin boards would be improved via better design techniques.

For the last four summers, the touch screen computer system purchased for the NPS booth at the 1982 Knoxville World's Fair has been set up at Sugarlands Visitor Center to test for a variety of potential applications. Programs were developed and evaluated for interactive trip planning. Collective visitor group interests, time frame, and degree of rigorous activity desired were used as parameters to select suggested itineraries for auto touring and hiking. Mail-back responses evaluating the system for auto touring indicated that 91 percent of people using the touch screen program for auto touring had followed the suggested itinerary and, of those using it, 85 percent indicated that the itinerary made the trip more fulfilling.

Programs to solicit public opinion also were tested. An assessment is presently being made as to how closely the computer users represent a cross-section of visitor types and if response weighting can be used to better fit the computer collected responses to the population norm. One series of questions tested related to marketing considerations for visitor services.

The response to the questions suggested that a large unmet market existed for visitor services. Results indicated that a large percentage (43 percent) of those potentially interested were unaware that programs existed. Ranger-led walks were the least preferred interpretive service among those listed.

A touch screen computer program was devised in 1984 to evaluate visitor use of the exhibitry installed at Sugarlands Visitor Center. Touch screen responses to questions concerning facts about specific exhibits correlated with observed use of the exhibits by the public. A serious signage flaw was discovered concerning the lack of public comprehension of a floor plan design to cluster exhibits by ecotype.

A self-contained interpretive program game was tested which targeted children. Interest choices led to a "visual" treasure hunt on a nearby nature trail, which encouraged family involvement and resulted in a recognition award.

A study of visitor behavior by Craig Walker and John Peine was conducted at three different kinds of hazardous areas where similar warning signage was used. Preliminary results indicate that very different group behavior occurred in confronting the three hazards, due in part to the nature of the hazard in conjunction with group dynamics.

Family groups were constantly putting small children on precarious ledges of a waterfall for family pictures at one site while another site was frequented primarily by local teenagers swimming and jumping off a 15 foot rock face. It was consistently observed that alcoholic beverages were hidden when ranger patrols appeared. The third site featured a steep rock face that led to a panoramic view. This hazard is obvious and treated cautiously by most hikers. In all three sites, the warning signage is very similar while the group dynamics and nature of the true hazards are quite diverse.

In 1983 John Bunde and Kevin Curran of Southern Illinois University conducted a comprehensive study of backcountry visitors at GRSM. One of the primary goals of their study was to assess how effectively the messages that were conveyed to them during the permit registration process were received by the hikers. The message given the most emphasis by park management concerned human/bear interactions. Study results indicated that bear encounters were quite common, with 39 percent of the hikers having an encounter. Only one in four hikers knew proper procedures to follow during a bear encounter, but another 65 percent had some knowledge. Messages concerning proper camping procedures to discourage bears tampering with food were similarly tenuously received by the park visitors.

In 1985 and 1986, a project was funded by the Man and Biosphere Program (MAB) to develop a model for incorporating community involvement in MAB programs. Gary Mullins of Ohio State University and Gabriel Cherem of Eastern Michigan University assisted John Peine in devising such a strategy. Steps of the process provide a straightforward means to identify key messages, target audiences, appropriate media application, and evaluative tools. The first test of the model will be the development of a community awareness program on air pollution related issues. One completed component is a series of school curriculum modules for grades 1-8 which have been developed on various aspects of MAB programs in the Great Smoky Mountains and include some key air pollution related topics.

Water Purification for *Giardia*: What Works in the Backcountry?

Editor's Note: Since the winter of 1980-81, when what was then Pacific Park Science (p. 10, Vol. 1, No. 2) published an account of a giardiasis outbreak in Olympic NP, the infection has gained Servicewide attention. Accordingly, Park Science revisits this distressing condition with updated guidance from three experts . . . an exhaustive treatment of an exhausting disease.

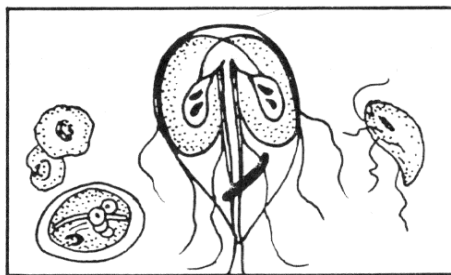
By Don L. Monzingo, Juliette Wilson,
and Sam Kunkle

Many backpackers and campers are now aware of the single-celled protozoan parasite *Giardia duodenalis* (= *G. lamblia*, *G. intestinalis*). They have been introduced to the disease, properly called giardiasis but also known as "beaver fever" or "backpackers disease," through the popular press, through brochures and pamphlets, by "word of mouth," or by becoming infected.

Infection results from ingestion of *Giardia* in its cyst form. Once in the gut, the cyst "excysts" into its reproductive, or trophozoite form, which thrives in the small intestine and multiplies to huge numbers. After a time the trophozoites "encyst" (return to the cyst form), and are passed in the stool. The cysts are extremely hardy in cold water and at 3°C can survive for up to three months.

Symptoms include diarrhea, abdominal cramps, flatulence, abdominal bloating, weight loss, and fatigue, varying from one person to another. Some individuals exhibit no symptoms; others develop severe gastrointestinal symptoms that can lead to a debilitating malabsorption-maldigestion syndrome; many more are somewhere in between. Those unaware that they have giardiasis become carriers of the parasite, and can spread the infection.

Giardia is transmitted from person to person most commonly via a direct fecal-oral route, but it is waterborne transmission that is attracting attention in national parks and other recreation areas. Here, cysts are introduced by an infected human or animal into a watercourse, where they can survive and remain infective for long periods, especially in cold waters. Downstream recreationists who consume the contaminated water risk ingesting the cysts and contracting giardiasis. Several species of domestic and wild



animals – including beaver, muskrat, dogs, cats, raccoons, cattle, marmots, and voles – can carry and transmit *Giardia*. Several outbreaks of waterborne giardiasis in communities using surface water for a source of drinking water have been traced to infected beaver living in the streams. An outbreak involving 34 of 54 campers in the Uinta Mountains of Utah occurred in 1974, and epidemiological evidence indicated that water drunk from the mountain streams was the source of infection (Barbour 1976). In a case-control study in Colorado giardiasis was again associated with drinking untreated mountain water (Wright et al. 1977).

Many mountain streams that appear pristine and safe for drinking are contaminated with *Giardia* cysts (Kunkle et al. 1985; Monzingo and Stevens 1986; Monzingo and Hibler 1987). It is therefore important to have a simple, reliable method for treating small quantities of water. Currently, the following treatments are used: 1) heating or boiling, 2) chemical disinfection, and 3) mechanical filtration. Each of these methods is effective to varying degrees, and each has its advantages and disadvantages.

Heating or Boiling Water

Heating water would appear the simplest and most reliable means of purification. If water contaminated with any viral, bacterial, or parasitic agent is maintained at a rapid boil for 10 to 20 minutes (State of New Mexico 1981; Brock and Brock 1986), it should be safe to drink. It has been found that bringing water only to 55°C will inactivate *Giardia* cysts in water (Monzingo and Aukerman, 1986, unpublished data).

Using heat to purify water means no chemicals to mix or filters to plug. On the other hand, a backpacker may find it impractical to carry enough fuel to boil water for drinking and cooking; and in many areas, suitable firewood is limited or campfires are prohibited. When *Giardia* is the only disease agent of concern, heating the water to just 55°C will provide savings in fuel, but a thermometer must be used to determine temperature accurately.

Chemical Disinfection of Water

Two chemicals, iodine and chlorine, commonly are used to render small quantities of drinking water safe. They are available as household products (bleach or tincture of iodine) or in commercially prepared tablets. Tablets include Halazone® (chlorine) and Globaline®, Coughlan's® or Potable Aqua® (iodine). An unopened, unexpired bottle of these tablets should be used, and the tablets protected from heat, direct sunlight, and exposure to the air. Directions on the label should be followed except as explained below. For bleach and tincture of iodine, Table 1 lists the amount of chemical and contact times as recommended in a brochure distributed by New Mexico's Health and Environment Department.

One method suggests iodine crystals to make a saturated iodine solution, which is then added in small amounts to the water to be disinfected (Kahn and Visscher 1975; Manley 1983). This method does not destroy *Giardia* cysts in very cold water (3°C) (Jarroll et al. 1980a). Because of this and the danger that the toxic iodine crystals could accidentally be ingested, this method is not recommended.

At water temperatures of 20°C, Halazone, Globaline, bleach, and 2% tincture of iodine destroyed *Giardia* with 20 to 30 minutes' contact time (Jarroll et al. 1980b). Potable Aqua is effective at 20°C with the 10-minute contact time recommended on the product label. (Monzingo and Aukerman, 1986, unpublished data). At 3°C with 30 minutes contact time, Globaline, bleach, and 2% tincture of iodine did not destroy all the cysts (Jarroll et al. 1980b), and Potable Aqua was not effective at 10°C with 10 minutes' contact time. (Monzingo and Aukerman, 1986, unpublished data). Therefore, water to be treated with any of these chemicals should be warmed to at least 20°C prior to chemical treatment. Solar radiation or body heat can be used to bring water to 20°C, but to be safe, a thermometer should be used.

Turbidity also will lessen the effectiveness of these chemicals. Turbid or cloudy water should be filtered through a cloth, and the contact time with the treatment chemicals should be at least double the time recommended on the bottle.

Mechanical Filtration of Water

Several brands of backpackable water filters are available. To reliably remove *Giardia* cysts from water, a filter must have a nominal pore size of 1 micron or less. Although *Giardia* cysts measure 9 to 12 microns in length and 5 to 8 microns in diameter, their pliability allows them to squeeze through openings 5 microns in diameter.

Two filter units widely accepted as effective in removing *Giardia* and most pathogenic bacteria and General Ecology's First Need® filter and the Katadyn® filter; both are EPA-certified to remove *Giardia* cysts. The units are expensive, ranging from \$35 to \$150,

Table 1. Amount of bleach or iodine needed for disinfecting 1 L of water. Adapted from State of New Mexico, 1981.

Chemical	No. of drops needed per L ^{1,2}	
	Clear water	Cold or turbid water
Bleach		
Available chlorine (listed on container label):		
1%	10	20
4-6%	2	4
7-10%	1	2
Unknown	10	20
Tincture of iodine		
2%	5	10

¹ 1 drop = 0.05 ml

² Mix water with chemical agent thoroughly in container by stirring or shaking. Let stand at least 30 minutes. Very cold or turbid water may require contact times of several hours.

Giardia: What Works in the Backcountry?

Continued from page 7

and filters in the cheaper units will eventually plug, requiring replacement at \$15 to \$18 per filter. The filters will plug rapidly if care is not taken to first remove debris and sediment from the water: turbid water should be strained through several layers of cloth prior to filtration and the filter intake should never be put directly in the stream. When used properly, these filter systems will provide large quantities of safe drinking water for several persons at a time. They are relatively easy to operate, and filtered water lacks the "flat" taste of boiling and the chemical aftertaste of disinfectants.

For many recreationists, a combination of methods works best, usually filtration or heat followed by chemical disinfection. The individual must make the final decision. The important message is that caution is the best policy in avoiding gastrointestinal illness: treat all surface water before drinking it, and if you are treating it for *Giardia*, be sure your treatment methods are effective!

Monzingo and Wilson are Research Associates and Sam Kunkle is Land-Use Hydrologist, NPS Water Resources Division, Colorado State University, Fort Collins.

Literature Cited

- Barbour, A.G., C.R. Nichols, and T. Fukushima. 1976. An outbreak of giardiasis in a group of campers. *Am. J. Trop. Med. Hygiene* 25:384-389.
- Brock, J. T., and R.M. Brock. Backcountry water: *Giardia* and other potential health hazards. (Brochure.) Stream Ecology Center, Idaho State University, Pocatello, ID.
- Jarroll, E.L. Jr., A.K. Bingham, and E.A. Meyer. 1980a. Inability of an iodination method to destroy completely *Giardia* cysts in cold water. *West. J. Med.* 132:567-569.
- Jarroll, E.L. Jr., A.K. Bingham, and E.A. Meyer. 1980b. *Giardia* cyst destruction: Effectiveness of six small-quantity water disinfection methods. *Am. J. Trop. Med. Hygiene* 29:8-11.
- Kahn, F.H. and B.R. Visscher. 1975. Water disinfection in the wilderness: A simple effective method of iodination. *West. J. Med.* 122:450-453.
- Kunkle, S., N. Cowdin, J. Wilson, J. Grondin, T. Ricketts, and M. Flora. 1985. Field survey of *Giardia* in streams and wildlife of the Glacier Gorge and Loch Vale basins, Rocky Mountain National Park. *Natural Resources Report Series 85-3*. National Park Service, Fort Collins, Colorado.
- Monzingo, D.L. Jr., and C.P. Hibler. (In press.) The prevalence of *Giardia* in a beaver colony and the resulting environmental contamination. *J. Wildlife Disease*.
- Monzingo, D.L. Jr., and D.R. Stevens. 1986. *Giardia* contamination of surface waters: A survey of three selected backcountry streams in Rocky Mountain National Park. *Water Resources Report No. 86-2*. National Park Service, Water Resources Division, Fort Collins, CO.
- State of New Mexico. 1981. *Water disinfection for campers and backpackers*. (Brochure.) Health Services and Environmental Improvement Division, Health and Environmental Department, Santa Fe, NM.
- Wright, R.A., H.C. Spencer, R.E. Brodsky and T.M. Vernon. 1977. *Giardiasis in Colorado: An epidemiologic study*. *Am. J. Epidemiol.* 105(4):331-336.

Three reports appear on these pages, covering various aspects of the Fourth World Wilderness Congress held Sept. 14-18, 1987, at Estes Park, Colo. Parsons gives a general account from the NPS point of view; Shelton (in his MAB Notes) describes the Biosphere Reserve symposium, and Baron reports on the acid rain symposium.

Fourth World Wilderness Congress Links Protection and Development

By David J. Parsons

A major theme of discussion throughout the Fourth World Wilderness Congress at Estes Park, Colo., Sept. 14-18, was the idea of linking environmental protection in the third world to the development process, including international banking decisions. Wilderness purists feared that such a union would compromise ideals, while others argued that it was the only alternative left. Consensus was not reached, and the topic promises to be a major one for debate in future forums.

The international gathering of representatives of governmental agencies, private interest groups, and academia represented one of the largest such meetings of its kind. The participants' list read like a who's who of wilderness and environmental cognoscente: Edgar Wayburn, David Brower, Rupert Cutler, Garrett Hardin, William Penn Mott, Jr., Joyce Kelly, Raymond Dasmann, etc. Spirited debate highlighted long days of plenary sessions, technical presentations and roundtable discussions.

Plenary sessions included panels on Wildlife and Protected Areas, Wilderness Land Use Planning, Biodiversity and Tropical Forestry, Natural Resource Management, Conservation Activism, and International Banking. Technical scientific sessions addressed Acid Rain Impacts on Wilderness, Parks and Nature Reserves (co-chaired by David Parsons of Sequoia and Kings Canyon National Parks), The Man and Biosphere Program (co-chaired by William Gregg, WASO), Designation and Management of Park and Wilderness Reserves, The Use of Wilderness for Personal Growth, Therapy and Education, and Population and Environmental Stress. In addition, workshops were held on topics ranging from Conservation Leadership to Wilderness Fire Management and Conservation Issues in Alaska.

A highlight of the Congress was the keynote address by Gro Harlem Brundtland, Prime Minister of Norway and Chairman of the World Commission on Environment and Development. She discussed the Commission's recently released report "Our Common Future," concluding that sustainable development is absolutely vital if we are to halt poverty and suffering as well as arrest environmental degradation. This presentation was followed by discussion of how Canada is addressing world environmental concerns. Thomas McMillan, Canadian Minister of the Environment, emphasized the environmental problems unguided development can cause as well as the need to better address the rights of all living organisms.

The Congress adopted a series of resolutions on 50 different topics. Each called for specific action to be implemented by groups attending the Congress. Resolutions called for the creation of an International Conservation Banking Program, establishment of a World Conservation Corps, and support for international cooperation and communication of non-governmental organizations. Additional resolutions called for preservation of specific wilderness or natural areas throughout the world.

The National Park Service was well represented at the Congress. In addition to Director Mott, attendees included representatives of the International Affairs Division, Alaska Regional Director Boyd Evison, a number of superintendents, resource managers, interpreters, and scientists. Rocky Mountain NP provided regular tour bus service and special interpretive programs for the delegates.

Parsons is a Research Scientist at Sequoia and Kings Canyon NPs.

Acid Rain Experts Find No Simple 'Cause and Effect'

By Jill Baron

A special symposium of "Acid Rain Impacts on Wilderness, Parks and Nature Reserves" was held as part of the recent World Wilderness Conference. Organized by John McCrone (CPSU, Clemson University), the symposium contained a poster session and four days of invited speakers organized into themes of atmospheric processes, effects on vegetation, and aquatic effects.

Complexity was a unifying thread running through most of the talks. Donald Whitehead (Indiana University) spoke of piecing together paleo-historical evidence to reconstruct the processes of acidification. Paleolimnological techniques document changes in lake, watershed, and atmospheric deposition over time, but this work shows how hard it is to exhibit simple cause and effect.

Mark Harmon (Oregon State University) spoke on the complexity of tree and whole forest response to perturbation. There may be extreme circumstances where air quality is so deteriorated from photochemical oxidants, heavy metals and acid deposition that acute effects are readily seen. Two case studies of these situations were given by David Cibrian, University of Mexico City, and by Jan Materna (Czechoslovakia). A more common situation was presented by John Skelly on pathological causes for forest or tree species decline: while air pollution may be responsible for loss of vigor in some instances, the confounding effects of other factors, such as long-term climate change, disease or insect infestation are so poorly understood that it is often difficult to understand cause and effect.

While it is well known that acidification of lakes will cause reproductive failure in fish, complexity was apparent in studies presented by David Schindler (Freshwater Institute, Winnipeg, Manitoba). Many species of aquatic organisms respond to very small shifts in aquatic chemical composition, so that the biological assemblage of lakes may change dramatically even

Acid Rain Experts

Continued from page 8

before fisheries start exhibiting adverse effects to acidification. Again, simple cause and effect were difficult to discuss, because sediment processes may ameliorate the effects of acid addition, or the abundance of base cations may enable species to withstand the influence of acidification.

The National Acid Precipitation Assessment Program (NAPAP) Interim Assessment was issued during the week of the World Wilderness Conference. The conclusions of the Assessment generally played down the importance of acidic deposition in causing environmental damage, in contrast to many of the conclusions reached through NAPAP-funded research. This caused a strong response from members of the symposium, all of whom are internationally-recognized experts in the field. According to paleolimnological reconstructions, lake acidity has not stabilized in many areas of North America, in direct contradiction of one NAPAP conclusion. Another NAPAP conclusion was based upon an arbitrary "acidification" value of 5.0 for determining the status of lakes. Lakes with pH above 5.0 were not considered acidified, again a direct contradiction of findings presented at the symposium detailing complex biological responses to even slight fluctuations in lake acidity.

Perhaps the most controversial NAPAP conclusion dealt with the effects of acidic deposition on forest vigor, stating that direct effects of acidic deposition are unlikely to cause damage to forests at current levels. However, since research results are inconclusive at this time, it was puzzling to the scientists at the symposium how such a conclusion could be reached.

Park Service research was well represented at the symposium. Bill Malm (Air Quality Division) was an invited speaker on sulfur dioxide sources causing visibility impairment in western parks. Posters were presented on research in Rocky Mountain, Sequoia, Isle Royale, Great Smoky Mountains, and Grand Canyon National Parks.

Baron is a Biologist with the NPS Water Resources Lab at Colorado State University.

Acid Dew Possible Factor In Tree Leaf Damage

"There is a possibility that dew in fact plays a very important role in harming trees," says William L. Chameides of the Georgia Institute of Technology in the Oct. 20 (1987) *Journal of Geophysical Research*. Acid dew forms when dewdrops absorb nitric acid and sulfur dioxide from the atmosphere (mostly originating as exhaust from autos and coal-burning plants) and become increasingly acid as other chemicals oxidize the sulfur dioxide to form sulfuric acid. While usually not harmful at night, these droplets become more acid-concentrated as the sun evaporates their ambient water.

In spite of its moisture composition, acid dew is an example of what scientists call dry deposition of trace atmospheric particles or gases. In the case of acid dew, the particles or gases in settling to earth alight on wet surfaces. Chameides's findings are showing that the mechanics of dry deposition may not be as simple as scientists had previously assumed.

mab notes

Biosphere Reserve Symposium. The Man and the Biosphere Program, one of five technical symposia held at the World Wilderness Conference in Estes Park, Colorado, Sept. 14-17, 1987, drew a packed house every day. Sixteen papers by participants from nine countries presented an evolutionary history of the biosphere reserve concept and a status report on its implementation in different regions of the world. In the poster session, 16 case studies showed how the concept is being applied in Canada, Costa Rica, Mexico, Panama, the Philippines, and the United States. At a workshop on the final day, lively discussion addressed opportunities, impediments, and priorities for implementing the biosphere reserve concept. The discussions yielded specific recommendations that supplement the more general recommendations in a resolution on biosphere reserves prepared by 10 symposium participants.

The papers illustrated the great functional variety of today's biosphere reserves. For instance, Y.A. Israel and S.M. Semenov discussed biological monitoring techniques in Soviet biosphere reserves, which stress this function. Bernie Lieff, in a paper supplementing his poster on Waterton Lakes, Alberta, describes how the national park core and adjacent landowners in the cooperative "transition area" search for solutions to elk management issues, impacts of oil exploration, and other mutual concerns through a Management Committee and a Technical Committee. Walter Lusigi stressed sustainable development in his exposition of the 10-year effort to create scientifically based guidelines for managing Mt. Kulal Biosphere Reserve and adjacent lands on the dry northern border of Kenya, where nomadic pastoralists face a deteriorating environment.

Structural variety of biosphere reserves also was evident. Carleton Ray's paper explored the establishment of coastal and marine reserves, with their peculiar zoning and management challenges. In Central Mexico, symposium participants learned, a large biosphere reserve containing populations of *Zea diploperennis*, the perennial wild relative of maize, has been established, but only one percent of the reserve is in public ownership. Cooperation between scientists and local people is the basis of this biosphere reserve.

In the midst of the learned gathering at Estes Park, a Kuna tribal leader from Panama perhaps expressed the biosphere reserve idea best of all: "For the Kuna culture the land is our mother, and all living things that live on her are brothers, in such a manner that we must take care of her and live in a harmonious manner on her; because the extinction of one living thing is also the end of another."

Copies of the following papers relating to national parks may be obtained from Bill Gregg in the Washington office: Caroline Rogers, no title (Virgin Islands Biosphere Reserve); Tundi Agardy and James Broadus, "Coastal and Marine Biosphere Reserve Nominations in the Acadia Boreal Region: Results of a Cooperative Effort between the U.S. and Canada" (includes Cape Cod NS and Acadia NP); Bernie Lieff, "Case Study: Waterton Biosphere Reserve" (some reference to Glacier NP); D. Wilson Crumpacker and William Gregg, "An Ecosystem Conservation Database for the United States" (macroreserves); and William Gregg, "On Wilderness, National Parks, and Biosphere Reserves" (definitions and philosophy).

FY1988 Research Budget. The Executive Committee of the U.S. MAB National Committee has approved a total FY1988 budget of \$940,000, assuming, with the usual uncertainties, that federal agencies will supply the funding requested. New MAB research is budgeted for \$440,000.

This year all research proposals must come from MAB Directorates and address one or more of the following MAB research themes: (1) ecosystem functioning under different intensities of human impact; (2) management and restoration of human-impacted resources; (3) human investments and resource use; (4) human response to environmental stress.

Preference will be given to proposals which concentrate their research activities on one or more of the following target areas:

- biosphere reserves;
- biological diversity;
- global climate and ecological change;
- biomes or ecotones of the arctic, arid lands, or tropics.

In addition, \$100,000 has been budgeted for five symposia on research themes 1-4, plus The Action Plan for Biosphere Reserves.

Anyone desiring more information or having an idea for a research proposal involving one or more biosphere reserves should contact Bill Gregg (202-343-8122). He points out that projects related to more than one MAB directorate tend to get more money.

Getting Together in the Southern Appalachians.

In August, representatives of five federal agencies met at Clemson University to discuss cooperation on regional resource issues in a MAB framework. Participants from the Economic Development Administration, Tennessee Valley Authority, the Department of Energy's Oak Ridge Laboratory, the Forest Service, and the National Park Service appointed a planning group which has now drafted a memorandum of agreement among federal agencies. If approved, this memorandum would establish a Southern Appalachian MAB Cooperative.

At present, John McCrone, Director of the Clemson University NPS/CPSU, and Tommy Gilbert, former NPS MAB Coordinator who first proposed such Southern Appalachian cooperation, are serving as an informal secretariat. The hope is to get money to staff a MAB Cooperative office, which would develop proposals for specific projects for the Cooperative. McCrone would seek broader support for the Cooperative among other organizations, including foundations. Thus far, the Southern Appalachian Research/Resource Management Cooperative (SARRMC) is being used as the umbrella for regional activities. On Nov. 3-4, 1987 SARRMC sponsored a conference in Asheville, NC on "The Southern Appalachians: Our Land, Our Future" which was expected to help structure the proposed MAB regional program.

Much of the regional research would focus on a biosphere reserve cluster composed of federal, state, and possibly private areas, all surrounded by a zone of cooperation that would include the whole Southern Appalachian region. Great Smoky Mountains NP and Coweeta Hydrological Laboratory already are part of the BR cluster.

Projects like this provide a dimension to conservation that recognizes the impossibility of achieving sustained development without understanding natural ecosystem processes. As we learn more about how these processes work, we are better able to maintain or restore the genetic diversity of species upon which the continuing evolution of these processes depends.

Napier Shelton
NPS Washington Office

meetings of interest

1988

January 13-16, RESTORING THE EARTH, 1988, a national conference on natural resource restoration and environmental planning, at U/Cal/Berkeley. Contact: UCB College of Natural Resources.

February 1-5, SAGIS/GRASS TRAINING SESSION in software and hardware in the OPUS Systems UNIX environment. Cost, \$100. (See story in GIS Notes this issue). Contact: Harvey Fleet, GIS Division, Digital Cartography Branch, NPS Denver, CO 80225; 8-327-2593.

March 3-4, HIGH ALTITUDE REVEGETATION WORKSHOP, at Holiday Inn, Fort Collins, Colo.; Contact: Gary Thor, Dept. of Agronomy, Col/State Univ., Fort Collins, CO 80523. (303) 491-6517.

March 16-19, OBSERVATIONS ACROSS SCALES: THE STRUCTURE, FUNCTION AND MANAGEMENT OF LANDSCAPES, symposium sponsored by the U.S. Regional Assn. of the International Assn. for Landscape Ecology, at U/New Mex., Albuquerque. Contact for paper/poster contributions: Monica Turner, Environmental Sciences Div., Oak Ridge National Lab, Oak Ridge, TN 37831; (615) 574-7329. Registration contact: Bruce Milne, Biol. Dept., U/New Mex., Albuquerque, NM 87131; (505) 277-3411.

April 20-23, INTERNATIONAL SYMPOSIUM ON VANDALISM: RESEARCH, PREVENTION AND SOCIAL POLICY. Sponsored by USDA Forest Service and the University of Washington Institute for Environmental Studies. Contacts: Dr. Chris Christensen, USFS, Pacific Northwest Research Station, 4043 Roosevelt Way, N.E., Seattle, WA 98105, (206) 442-7846; and Polly Dyer, Institute of Environmental Studies, U of WA, Seattle, WA 98195.

May 16-22, INTERNATIONAL CONFERENCE ON UNGULATE BEHAVIOR AND MANAGEMENT, at Texas A&M, College Station, TX. One-page abstracts due Jan. 1, 1988. Contact for attendance or contributions: Dr. Elizabeth Cary Mungall, 342 Double Tree Drive, Lewisville, TX 75067.

June 6-9, ECOSYSTEM MANAGEMENT: RARE SPECIES AND SIGNIFICANT HABITATS, at State Univ. of NY, Syracuse; in conjunction with the 15th Annual Natural Areas Conference and the 10th Annual Meetings of the Natural Areas Association. Contact: ESF Continuing Education, SUNY College of Env. Sci. and Forestry, Syracuse, NY 13210-2784.

July 5-8, INTERNATIONAL ASSN. FOR IMPACT ASSESSMENT (IAIA) ANNUAL MEETING, at Griffith University, Brisbane, Australia. Meeting theme: "Integrating Impact Assessment in the Planning Process." Contact: Rabel J. Burdge, Institute for Environmental Studies, University of Illinois, 408 S. Goodwin Ave., Urbana, IL 61801; (217) 333-2916.

August 7-11, ELEVENTH NORTH AMERICAN PRAIRIE CONFERENCE, on "Prairie Pioneers: Ecology, History & Culture"; at the University of Nebraska-Lincoln. Abstracts due March 1. Contact: Thomas B. Bragg, 11th NA Prairie Conf., Dept. of Biology, University of Nebraska at Omaha, Omaha, NE 68182-0040; (402) 554-3378.

August 14-18, SOCIETY FOR CONSERVATION BIOLOGY, Second Annual Meeting, to be held jointly with the American Institute of Biological Sciences and the Ecological Society, at the University of California, Davis. Contact Christine Schonewald-Cox, Institute of Ecology, Wickson Hall, U/Cal, Davis, CA 95616; (916) 752-2088.

November, CONFERENCE ON SCIENCE IN THE PARKS, sponsored by the George Wright Society with the National Park Service and co-chaired by R. Roy Johnson, Leader of the NPS/CPSU at University of Arizona, Tucson, AZ 85721, (602) 762-6501 and James Judge, Director, Fort Burgwin Research Center, P.O. Box 300, Ranchos de Taos, NM 87557, (505) 758-8322. Specific dates and meeting place in Tucson to be announced.

Natural Areas Association Boasts Record Attendance at Annual Meeting

The Natural Areas Association's 14th Annual Meeting was held in Peoria, Illinois on October 13-16, 1987. More than 400 natural area professionals attended representing forty-one states, four Canadian provinces, and six foreign countries. Participants were treated to plenary addresses by Glenn Juday, NAA President; William P. Mott, Director of the NPS; Larry Hensen, Associate Deputy Chief of the U.S. Forest Service; and James R. Thompson, Governor of Illinois. As has become characteristic of NAA conferences, talks, roundtable discussions, and field trips offered valuable information for natural area and park managers, resource managers, interpreters, and researchers. Program topics included urban natural

areas, effects of habitat fragmentation, exotic species, interpretation of natural areas, volunteers, resource planning, international conservation, presettlement vegetation, and inter-agency cooperation. Participants had a choice of twelve field trips and the opportunity to assist in a prescribed burn and exotic plant removal. This is the third year I have attended the annual NAA conference and have found all to be relevant, practical, and enjoyable.

The next annual meeting will be held in conjunction with the State University of New York College of Environmental Science and Forestry in Syracuse, New York on June 6-9, 1988. The conference theme will be "Ecosystem Management; Rare Species and Sig-

nificant Habitats."

Membership in the Natural Areas Association is a real bargain at \$15.00 a year. It includes your subscription to the *Natural Areas Journal*. Quarterly issues contain articles relating to research or management activities for natural areas, parks, etc.; rare species management; land preservation techniques; theoretical approaches to natural areas work; book reviews; and editorials. A new section appearing in 1988 will facilitate rapid communications among natural area and park professionals. The journal provides valuable and readable information for all park professionals from superintendents to interpreters, from maintenance personnel to researchers. It also provides a forum to communicate research results, new management techniques, or opinions.

For further information on the Natural Areas Association and its next annual meeting, write to The Natural Areas Association, 320 South Third Street, Rockford, Illinois 61108. For information on the *Natural Areas Journal*, write to the Managing Editor, Holly Wheeler, *Natural Areas Journal*, Holcomb Research Institute, Butler University, Indianapolis, Indiana 46208.

Ron Hiebert is the Chief, Division of Science, at the Indiana Dunes National Lakeshore.

Interpreters Form New Organization

The 1987 National Interpreters Workshop, held Nov. 2-5 in St. Louis, Mo., was a resounding success in more ways than one. First, 600 participants were expected but about 900 actually showed up, in overwhelming response to the new National Assn. of Interpreters (NAI), formed by a merger of the Assn. of Interpretive Naturalists and the Western Interpreters Assn. The NAI became a reality on Jan. 1, 1988 and its membership now will come not only from the traditional ranks of naturalists, historians and rangers, but also from educators, museum curators, administrators, recreation specialists and so on.

About 175 NPS interpreters attended the St. Louis workshop, which showcased first rate presentations by speakers from around the nation. Highlights included a keynote address by Thomas Crum, first executive director of the Windstar Foundation, which he co-founded with John Denver. His presentation was on conflict resolution. Jim Poisant of Walt Disney World spoke about the Disney approach to people management.

A dinner buffet at the Missouri Botanical Gardens featured guest of honor NPS Director William Penn Mott, Jr., who presented the Freeman Tilden award to the 1987 winner - Carol Spears of Cuyahoga Valley NRA.

Following the workshop, Ken Raithe, Asst. Director for Interpretation, and Mike Watson, both of the Washington Office, met with all the Regional Chiefs of Interpretation to discuss "The Interpretive Challenge" - new directions for future NPS interpretation.

Mike Gurling, Interp. Mgt. Trainee
Pacific Northwest Regional Office

Restoring the Earth

"Restoring the Earth Conference - 88," billed as "the most comprehensive gathering ever held on the subject of ecological restoration," will take place on the U/Cal Berkeley campus Jan. 13-16, with NPS Research Scientist Stephen Veirs as the *Park Science* reporter. Veirs' account of the meeting will be carried in the Spring 1988 issue of this bulletin.

information crossfile

Controversy over reestablishment of wolves in the U.S. wild has spilled over into the popular press. A *New York Times* article by Philip Shabecoff was picked up in early November by member newspapers, describing strong Congressional opposition to "an ambitious experimental program to reintroduce Rocky Mountain timber wolves, a subspecies of the gray wolf, into the northern Rockies." Shabecoff credits NPS Director William Penn Mott with "strong support" for the recovery plan, but says that "it has been put on the shelf by Frank Dunkle, director of the (U.S. Fish and) Wildlife Service after vigorous protests by members of Wyoming's Congressional delegation ..."

Director Mott is quoted as believing that "proper management could solve any problems caused by re-entry of the wolf into Yellowstone." But ranchers, according to Shabecoff, "seem to be adamantly opposed to the wolf under any circumstances."

Shabecoff also quotes Wildlife Biologist L. David Mech as observing that wolves and the livestock industry appear to be co-existing reasonably well in Minnesota. "There has been a lot of opportunity for wolves to kill livestock (in Minnesota)," Mech said, "but they haven't. They live on wild prey."

**

Anyone interested in developing actions and public information materials on "the great wolf controversy" is advised to contact Norm Bishop, P.O. Box 168, Yellowstone NP, WY 82190. Bishop can tell you what is available, where it can be had, how to get it, etc., from teacher packets on wolves and humans to cassette tapes of wolf howls, to books, to films, to you name it.

Bishop notes that "anyone who wants quickly to become introduced to the history of wolves in Yellowstone, wolf ecology, and the Northern Rocky Mountain Wolf Recovery Plan (the NPS Director is "for it," the USFWS Director is "agin it"), can take the Yellowstone Institute course - The Wolves of Yellowstone - conducted by John Weaver, author of the 1978 report by that same title. Weaver is now grizzly bear habitat coordinator for the USFS in Missoula.

"Having answered hundreds of requests for information, and responded to a number of hostile anti-wolf interests," Bishop writes, "we have a reasonably good idea of the concerns expressed by a broad range of correspondents, and have had to dig out answers to them." Many of these concerns are answered in the four-page paper "Wolf Recovery in Yellowstone NP," which can be had by contacting Bishop.

**

In an addendum to his Yellowstone wolf recovery article in the Fall 1987 issue of *Park Science* (p. 19), Norm Bishop writes:

"Sept. 30, 1987, in the U.S. House of Representatives, Mr. Owens of Utah introduced a bill, H.R. 3378, to require the National Park Service to reintroduce wolves into Yellowstone National Park. The bill was referred to the Committee on Interior and Insular Affairs. Section 1 says: 'The Secretary of the Interior, acting through the Director of the National Park Service, shall take such steps as may be necessary to reintroduce wolves into Yellowstone NP. The project to carry out such reintroduction shall be commenced as expeditiously as practicable and shall be completed within 3 years after the date of enactment of this Act.'"

Dunkle Flunks Fairy Tale

The Environmental Defense Fund, with permission from *USA Today*, reprinted the following article headlined "Fish and Wildlife Service Cries Wolf."

"Fish and Wildlife Director Frank Dunkle apparently mixed up Goldilocks and Little Red Riding Hood in testimony to a House hearing on endangered species. He said one problem with reintroducing wolves into Yellowstone NP is the public's exaggerated fears of wolves, reinforced by fairy tales like Goldilocks being eaten by one. Environmental Defense Fund lawyer Michael Bean then told the panel: 'Far from being eaten by a rapacious wolf, Goldilocks messed up the beds, broke the chairs and stole the food of a law-abiding family of bears after breaking and entering their home.'"

**

The final (fourth) article of a series entitled "Genetic Resources: the Founding Years," appears in issue No. 11 (1987) of *Diversity*, a news journal for the plant genetic resources community. Authored by Sir Otto Frankel, an honorary research fellow in the Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization in Canberra, Australia, the series traces the international genetic resources movement from the 1960s through the present. *Diversity* is published at 727 8th St., S.E., Washington, DC 20003, (202) 543-6843.

**

A grant from a private organization and proceeds from a bighorn sheep tax auction financed an Oregon Dept. of Fish and Wildlife effort to trap and transplant about 50 bighorn sheep in southeastern Oregon, starting in mid-October 1987. The operation was funded by a \$10,000 grant from the Foundation for North American Wild Sheep and income from Oregon's first big-horn sheep tag auction earlier in the year. Biologists attached radio collars to adult ewes for monitoring after the animals were moved to three former bighorn ranges.

The Foundation is headquartered in Cody, WY, and is dedicated to conservation, propagation, and management of wild sheep and their habitats in North America.

**

Two more reviews of the Alston Chase book *Playing God in Yellowstone* appear in the summer issue of *Restoration and Management Notes* (5:1, pp. 18-22). The first is by Keith Sendt of the Natural Heritage Program, Minnesota DNR, St. Paul 55155, and the second by Michael E. Gilpin, biology department, U/Cal San Diego.

**

The Social Science Research Council, 605 Third Ave., New York, NY 10158, is offering a 66-page guide to fellowships and grants for training and research in 1988, detailing limitations, eligibility and application information. The phone number is (212) 661-0280.

**

James A. Kushlan, former NPS research scientist at Everglades NP and now professor of biological sciences and director of the Center for Water Resources Studies at East Texas State U, was a lecturer at the recent NPS Resource Managers training course at Texas A&M. In addition to being made a full professor, directing an interdisciplinary research center, and receiving last year's Distinguished Professor award from the Univer-

sity, Kushlan has authored six papers based on his work in the Everglades and published in various journals and by the University. They include the history of the southern Florida wood stork population, alligators in natural areas (and choosing conservation policies consistent with local objectives), the management of cumulative ecosystem degradation in the Everglades, the hydrologic regulation of the Everglades (external threats and internal management), decreases in the southern Florida brown pelican population, and responses of wading birds to seasonally fluctuating water levels.

Reprints are available from Kushlan at the University, Commerce, TX 75428.

Kushlan also edits the international *Journal of the Colonial Waterbird Group*.

**

An Intermountain Research Station (USFS) Report entitled *Proceedings - Grizzly Bear Habitat Symposium*, General Technical Report INT-207, is now available from the Station at 324 25th St., Ogden, UT 84401. The Report contains 33 papers and three abstracts including state-of-the-art information on grizzly habitat delineation and management and is a record of the Interagency Grizzly Bear Committee symposium held in Missoula, MT, the Spring of 1985, with more than 350 attendees from land management agencies, industry, universities, and Federal and State research organizations.

**

Peter Gogan, wildlife research biologist at Voyageurs NP (P.O. Box 50, International Falls, MN 56649), announces availability of four reprints: "Comparative dynamics of introduced Tule elk populations" in *Journal of Wildlife Management* 51 (1): 20-27; "Cleft palate in a Tule elk calf" in *Journal of Wildlife Diseases* 21 (4), 1985, pp. 463-66; "Paratuberculosis in Tule elk in California" in *Journal of the American Veterinary Medical Assn.*, Vol. 179, No. 11, pp. 1252-54; and "Line-transect censuses of fallow and black-tailed deer on the Point Reyes Peninsula" in *California Fish and Game* 72 (1): 47-61. Gogan was the lead author in all four articles.

The three elk articles are segments of a final report, *Ecology of the Tule Elk Range, Point Reyes NS*, by the Dept. of Forestry and Resource Management, U/Cal, Berkeley, under contract to the NPS Western Regional office ... a study that was a cooperative effort of the Seashore resource management staff, the California Fish and Game department, and the University, whose researchers worked as volunteers in the parks.

**

In addition to its usual wealth of "notes" on restoration and management of prairies, forests, wetlands, lakes and streams, and so forth, the Summer 1987 (Vol. 5, No. 1) issue of *Restoration and Management Notes* contains two thought-provoking editorials on the roles and goals of ecological restoration and management efforts. The one by *R&M Notes* editor Bill Jordan relates restoration to "reparation" - a word reflecting the ethical significance of our effort to "repair" what we ourselves have undone. "As an ecologically oriented, practicing environmentalist," Jordan writes, "the manager's prime concern is not with objects as such or in isolation ... It is with relationships - and, I would venture, especially with the relationship between our species and the rest of nature."

Guest Editor Darrel Morrison (dean of the U/Ga School of Environmental Design) adds the element of "beauty" to the list of restoration considerations. The omission of aesthetic quality, or beauty, as an objective, he suggests, may lie "in the recognition that beauty is inextricably linked with biological integrity."

Information Crossfile

Continued from page 11

A thought-provoking article by I.A.W. Macdonald in the July 1987 issue of *South African Journal of Science* was sent to us by Lloyd Loope, NPS Research Scientist at Haleakala NP, Hawaii. Macdonald, who is in the Percy FitzPatrick Institute of African Ornithology, University of Cape Town, South Africa, compares the South African Wildlife Management Association's third thematic symposium in Pretoria in July 1986 to the July 1987 Science in the National Parks conference in Fort Collins, Colo., held immediately following the Pretoria meeting.

Macdonald compares the two conferences point by point, observing that one of the major differences was "the emphasis on the politics of conservation throughout the American meeting." He offers the opinion that "conservation in the USA is now suffering from 'too much democracy' (epitomized by the inability of the National Park Service to implement ecologically desirable fire regimes or cost-effective feral donkey control programmes in some of their parks because of 'public pressures'). Yet the willingness of managers and researchers to debate these political realities in public was highly commendable."

**

Bill Jordan, editor of *Restoration and Management Notes*, sends word of a new group a-borning: the National Association of Ecological Restoration. The creator of this new organization is John Rieger, ecological manager for the California Dept. of Transportation. His post office box is 85406, Dept. of Transportation, District 11, 2829 Juan St., San Diego, CA 92138. Rieger has sponsored two symposia on California native plants and revegetation, and recently decided the time was ripe to make this effort nationwide. To contact Rieger by phone, call (619) 237-6754.

**

Two articles relating to resource issues facing Sequoia and Kings Canyon NPs (SEKI) appeared in the August 1987 (Vol. 37, No. 8) issue of the *International Journal of Air Pollution Control and Hazardous Waste Management* (JAPCA). Research Scientist Dave Parsons of SEKI sent in copies of the two technical papers, one by David L. Peterson et al on "Evidence of Growth Reduction in Ozone-Injured Jeffrey Pine in Sequoia and Kings Canyon National Parks," and one by Donald C. Petcher on "Fire History and Age Structure in Red Fir Forests of Sequoia NP, California." Wrote Parsons:

"The Peterson et al article documents apparent reduction in growth for pines showing symptoms of ozone damage on west slopes of these parks. While the lack of data on ozone concentrations for the alleged 'control' sites in the Kern drainage limits their ability to draw direct cause and effect relationships, there appears to be little doubt but that ozone injury can reduce growth in Jeffrey pine. If true, this represents the first documentation of ozone effects on mature trees in these parks.

"The article by Petcher provides valuable information on a forest type that we know little about. I suspect his plots are included in the area hit by white fir needle miner this year. If so, they will provide a valuable reference for evaluating the effects of this native pest."

**

From Doug Houston at Olympic NP comes word of an article in the *Journal of Applied Ecology* (1987, 24, 381-401), "To Cull or Not to Cull: Lessons from a Southern African Drought," by Walker, Emslie, Owen-Smith and Scholes.

The article notes that "few issues in conservation and wildlife management generate more heat than the culling of animals in conservation areas." The authors examine the ecological consequences of a severe drought on four wildlife conservation areas in southern Africa, and conclude that "culling is ecologically unnecessary where sufficient spatial heterogeneity exists to provide reserve forage. Some drought-related mortality is natural and probably beneficial to both animal and plant populations. Wild ungulate populations should be allowed to fluctuate within limits set by management objectives and culling is likely to be necessary only where the provision of water points has eliminated reserve forage areas."

**

A proposal to modify the aims of several large Canadian National Parks, so that they can serve as ecological baseline control areas (e.g. Kluane, Wood Buffalo, Auyuittuq, Prince Albert), is presented in *Park News*, the journal of the Canadian Parks and Wilderness Society, (pp. 4-7, Summer 1987 issue), by A.R.E. Sinclair of The Ecology Group, Department of Zoology, University of British Columbia.

Sinclair cites the Sahel zone of West Africa and its serious famine in the 1970s—a condition thought to have been brought about by low rainfall. A photointerpreter studying NASA satellite imagery discovered a polygon of green amidst the denuded Sahel—a government ranch fenced to exclude the nomadic peoples. Acting as an unintentional control, this ranch demonstrated that it was the nomadic pastoralists, not the low rainfall alone, that precipitated the widespread starvation and death from famine.

Sinclair suggests nine actions having to do with monitoring and a national data collection system that will make these large, largely natural areas most useful as baselines against which to measure our manipulated systems.

**

David Manski, Natural Resource Specialist at Aniakchak National Monument and Preserve in Alaska, sends word that more than 600 county bulletins and maps showing pesticide uses for counties where federal endangered species are located, are being released for public review by the Environmental Protection Agency over the next several months. EPA may prohibit the use of many pesticides in areas harboring endangered plant and/or animal species, the prohibition to be based on how the pesticides are labeled, not how they are applied.

Copies of the maps and bulletins are available from state Cooperative Extension Service Pesticide Coordinators and Wildlife Specialists, or by writing Charles Smith, Dept. of Pesticides Coordinator, Agricultural Research Service, Room 353-A Administration Building, USDA, Washington, DC 20250.

**

The October 16, 1987 issue of *Science* (Vol. 238, pp. 410-411) contains a book review of *Ecological Theory and Integrated Pest Management Practice*, edited by Marcos Kogan and published by Wiley-Interscience, New York 1986. The volume consists of 12 papers—the Proceedings of a symposium in San Antonio, Tex., in December 1984.

According to reviewer Ronald J. Prokopy of the U/Mass Department of Entomology, this volume is "the most sophisticated treatment of related aspects of ecological theory and IPM practice available under one cover."

The philosophical core of IPM, Prokopy points out, is holistic. "Ideally," he writes, "it provides for integration of approaches to maintaining pests below damaging levels and for attention to the effects human intervention may have on multiple components of the ecosystem. Even so, IPM has fallen short of attaining its ideals, at least partly because of its lack of a sufficiently broad and robust conceptual background rooted in ecological theory."

The 12 papers here assembled are by "some of North America's most astute and provocative ecological theorists and ecologically minded pest management proponents," according to Prokopy. A park-oriented review of this volume for the Spring 1988 *Park Science* is promised from IPM director Gary Johnston of the Washington NPS office.

**

State of the World, edited by Lester R. Brown, the Worldwatch Institute's 1988 report on progress toward a sustainable society, is now available in paperback. This desktop reference, fully indexed and referenced and containing more than 70 figures and tables, is available for \$9.95 (\$6.95 each for 2-4 copies; \$4.95 each for 5 or more copies) from Worldwatch Institute, 1776 Massachusetts Ave., NW, Washington, DC 20036.

**

European Forest Decline Sparks Tree Death Interest

Are the trees in your park dying? Is this a natural dieback or caused by human-induced stress? Tree death is becoming an ecological research focal point, particularly with the widespread European "Waldsterben" and forest declines in other areas.

The September, 1987 issue of *Bioscience* contains seven articles dealing with the cause and consequences of tree death on ecosystem species composition, structure, and function. The articles include "Tree death as an ecological process," "Tree life tables," "Characteristics of trees predisposed to die," "Natural diebacks in forests," "Competition and tree death," "Dynamic ecosystem consequences of tree birth and death patterns," and "Modeling the climate dynamics of tree death." These articles demonstrate the importance of tree death in ecosystem dynamics. We may not always know why a tree dies, but we are beginning to understand its relevance.

The articles stress the interdependence of tree death and tree establishment at the level of the individual tree, the tree stand or community, and the landscape. So-called "gap models" have been used to simulate such interactions at small scale in a variety of temperate and tropical forests. From these articles, it is clear that landscape-level models will be a focus of future research.

James K. Agee, Research Scientist
NPS/CPUSU, UWash.

regional highlights

Rocky Mountain Region

Colorado Plateau parks are making progress on developing desktop Geographic Information System (GIS) capabilities. Capital Reef, Bryce, and Glen Canyon have acquired the necessary hardware and are developing a digitized database from existing USGS data as well as mapping available resource data for eventual inclusion. As funds become available, more parks throughout the region will increase their capability of resource data analysis. A regionwide GIS plan is being prepared by the Regional Office in cooperation with the Geographic Information System Field Unit (WASO).

* * *

The Rocky Mountain Regional Office welcomes a new addition to the Branch of Natural Resource Management. Dr. Robert Schiller recently joined the staff as the Assistant Chief Scientist for the region. Dr. Schiller brings a great deal of experience to the region, primarily in the area of natural resource/planning issues in the Western, Pacific Northwest, and Alaska Regions.

* * *

Peregrine falcon populations are responding well to major recovery efforts throughout the region. It is too early to evaluate field data, but the trend is positive. Future plans include continued monitoring of known eyries and surveying potential habitat for new sites. A peregrine workshop is proposed for spring 1988 in Grand Junction, to include classroom instruction and field work monitoring known eyries and searching out new ones.

As an outgrowth of a study conducted by the U/Wyo/NPS Research Center at Glacier NP, an article on "Glacier National Park and Its Neighbors: A Study of Federal Interagency Relationships," by Joseph L. Sax and Robert B. Keiter appeared recently in the *Ecology Law Quarterly*, XIV(2):207-263, and sheds light into park protection debates.

Alaska Region

Two young male wolves, radiocollared in a study of wolf population ecology at Gates of the Arctic NP and Preserve by Regional Wildlife Research Biologist Layne Adams and Game Biologist Bob Stephenson (Alaska Department of Fish and Game), dispersed in late spring and were recently found in the Northern Yukon Territories, Canada by staff of the Arctic National Wildlife Refuge, USFWS. This constitutes a straight-line dispersal of approximately 320 miles. One of the wolves was observed with a female wolf who had been radiocollared by wolf researchers in the Yukon. Documenting this dispersal was made possible through close interagency and international cooperation. The activities of these wolves will continue to be monitored by the Yukon Fish and Wildlife Branch. Adams presented a report on the status of the wolf study at the First Northern Wolf Research and Management Meeting held at Tok, Alaska, July 27-29, 1987. The meeting was attended by wolf biologists from Alaska, and the Yukon and Northwest Territories, Canada.

* * *

Layne Adams gave a paper at the Third North American Caribou Workshop held November 3-5, 1987 in Chena Hot Springs, Alaska entitled "Neonatal Mortality in the Denali Caribou Herd." Bruce Dale and Frank Singer coauthored the paper in which the results of ongoing research into the causes and extent of caribou calf mortality at Denali NP and Preserve are summarized. An extended abstract is available from the senior author (Adams).

* * *

Dianne Osborne was selected to fill the Region's Remote Sensing Application Specialist position and has begun work to develop GIS data bases for each park in the region. She transferred from BLM in Anchorage, where she served as GIS coordinator.

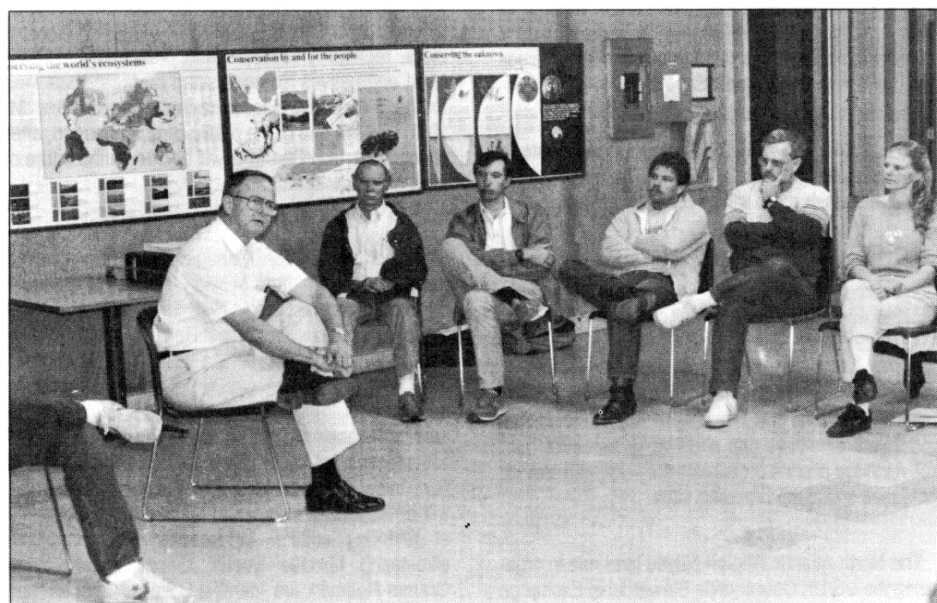
* * *

Brad Cella has accepted a position in the regional office as Resource Management Specialist. From 1982 to 1987 he served as Resource Management Specialist at Wrangell-St. Elias NP and Preserve and was a graduate of the Service's first training program for Natural Resource Specialists in 1984. He has also held assignments at Yosemite and Glacier NPs.

Mid-Atlantic Region

NEWS FLASH! PRESENTATION BY CHIEF SCIENTIST INCITES RIOT!

Four individuals were arrested for disruptive behavior during a presentation at a public meeting by Mid-Atlantic Region Chief Scientist John Karish at the Upper Delaware Scenic and Recreational River. Karish was presenting an overview of recent research accomplishments and results when the disorderly behavior began. Repeated efforts to restore order were unsuccessful. Karish was later presented an award for "Grace Under Pressure" by Supt. John Hutzky.



Gene Hester (left), NPS Assoc. Director, Natural Resources, attended a recent Mid-Atlantic Regional Resources Monitoring Course, where he discussed NRAAP – the Natural Resource Assessment and Action Program, the new Inventory and Monitoring Program initiative, and other matters. The tennis shoes at far left belong to Regional Chief Scientist John Karish.

Regional Biologist Jeff Marion and USFS Research Ecologist Dave Cole announce availability of three new Regional Research/Resources Management Reports: Report 27 – Ecological impacts on recreational sites at New River Gorge National River, W VA; Report 28 – Ecological impacts on recreational sites at the Upper Delaware Scenic and Recreational River, PA-NY; and Report 29 – Ecological impacts on recreational sites at the Delaware Water Gap NRA, PA-NJ.

* * *

Erv Gasser, Resource Manager at Richmond NBP, reports initiation of an experiment to evaluate the effectiveness of various methods for converting exotic honeysuckle vegetation to native tall grasses on historic earthworks. Methods to be tested include treatments with the herbicide Roundup and possibly 2,4 D, plantings of *Andropogon* plugs, and prescribed fire.

* * *

The final River Management Plan for the Upper Delaware Scenic and Recreational River has been signed by the Secretary of Interior and will take effect in January barring changes by Congress. The Plan's approval is a significant step in what has been a long and controversial process for initiating management of the new "greenline" park. The Plan calls for the formation of an Upper Delaware Council, representatives from 15 towns and townships, two states, and the NPS, to be responsible for coordinating the management plan implementation.

Water Resources Division

A Summary of Precipitation Monitoring Program, North Cascades NP Complex, 1980-85, by Robert Wasem and Sarah Spaulding, is now available from the NPS Water Resources Division, 301 Howes St., Fort Collins, CO 80521.

* * *

A Field System for Rapid Preconcentration of Trace Metals in Natural Waters, by D. Heimbecker, R. Skogerboe, and S. Kunkle, published in August 1987, may be had by contacting Juliette Wilson, NPS, Colorado State University, Fort Collins, CO 80523.

Regional Highlights

Continued from page 13

Aquatic Resource Branch staff met with Carol Johnston of the Minn. Natural Research Institute and Midwest Regional Chief Scientist Mike Ruggiero at the Great Lakes Biological Conference in Duluth to discuss application of some of the newer GIS methods applied to land use survey as a possible method for anticipating changes in water quality and threats to natural resources in St. Croix National Scenic Riverway. A paper co-authored by Dave Beeson of Col/State/U and Doug Wilcox of Indiana Dunes NL was presented: "The effect of two centuries-old low head dams on the macrophyte community, carbon transport, and the macroinvertebrate community of the Namekagon River, St. Croix NSR."

* * *

Resource inventory and environmental monitoring is the theme of a recent NPS national initiative, cooperatively planned by Midwest Chief Scientist Mike Ruggiero, Dr. Boris Kondratieff, and Water Resources Division staff and addressing resource inventories and subsequent monitoring for six small Midwestern parks. The plan involves a doctoral level program in the Dept. of Entomology at CSU and the resource management programs at the various parks, work to begin in November 1987.

North Atlantic Region

NAR is working with Dr. Marjorie Winkler of the University of Wisconsin - Madison in documenting the natural acidity of kettle ponds in the Cape Cod National Seashore. Mass. state agencies believe that acid deposition has ruined these lakes as trout habitat. Paleolimnological evidence indicates that these oligotrophic, glacial outwash lakes have been acidic for 12,000 years in varying degrees and have never supported endemic trout populations. Dr. Winkler's research will be out soon in *Ecology*.

* * *

Stan Ponce and Bill Werrill (NPS Water Resources Division - Ft. Collins) are assisting in developing a monitoring strategy for the future water supply issues which will face Cape Cod NS.

* * *

Mike Soukup has been selected to participate in the Natural Resources One-Month Training Assignment. His assignment will begin in mid-November.

* * *

Dr. Howard Ginsberg is continuing the reconnaissance phase of his Lyme disease work. Deer ticks infected with the spirochete virus that causes this disease have recently been found as far north as Acadia NP.

We are convening a working group to study alternatives for restoring the Fire Island NS marshes that underwent extensive grid ditching for mosquito control. As those ditches deteriorate they clog and provide increased mosquito breeding sites.

* * *

The North Atlantic Region played lead role in organizing the US/UK Countryside Stewardship Exchange which took place at five sites during the week of July 13, 1987. Twenty leaders from the UK conservation movement including staff from the Lake District National Park, Countryside Commissions for England, Wales and Scotland, other government and non-

governmental organizations met with their US counterparts. Consultation teams visited sites in New England that are experiencing rapid changes in the landscape and recommendations were made to the communities. The reports were well received and the participants are currently planning for future exchanges to sustain the network.

Pacific Northwest

A succinct and well documented perspective on "Research in Parks: An American Perspective" by NPS Research Scientist Doug Houston appears in the Summer 1987 issue of *Park News* (pp. 27-29), the journal of the Canadian Parks and Wilderness Society. Houston traces the formal NPS science program from its beginning in 1930 (58 years after establishment of Yellowstone NP), through its "cyclical patterns of growth, neglect, and recovery," (citing Cliff Martinka's 1985 paper at the North American Wildlife Conference).

The article continues with a typical Houstonian observation: "(In fact, bar room theorists have reported a remarkable similarity between the cyclic fluctuations in numbers of NPS scientists and the 'unstable equilibrium' model of herbivore dynamics, Caughley, G., 1976, in Coaker, T.J. ed. *Applied Biology*, Vol. 1 Academic Press, pp. 183-246. In this model, populations oscillate with increasing amplitude over time; the end result, invariably, is extinction!)"

* * *

Studies of Hydrothermal Processes in Crater Lake: A Preliminary Report of Field Studies Conducted in 1987 for Crater Lake NP, by Robert Collier and Jack Dymond, Oregon State U College of Oceanography, has been submitted to the NPS Washington Office for transmittal to the Secretary of the Interior. NPS Aquatic Research Biologist Gary Larson's *Crater Lake Limnological Studies, 1986* is now available from the OSU CPSU in Corvallis, Ore.

* * *

Five public meetings were held in five different cities in the Olympic NP area between Nov. 17 and Dec. 8 with regard to management of mountain goats at Olympic NP. The 88-page Environmental Assessment, recapping research and presenting management alternatives for addressing the goat issue was the basis for public discussion and response. Dec. 31, 1987, was the end of the public comment period, after which Supt. Bob Chandler will decide on the future of park goat management.

* * *

An Arid Vegetation Management Workshop was conducted at Whitman Mission on Nov. 19-20. Park participants represented seven parks with arid vegetation in the Pacific Northwest Region. Lava Beds National Monument also sent a representative. Objectives of the workshop were to: 1) share information on problems, management objectives, mitigation efforts, and research, and 2) to identify components of a work plan for fiscal years 1988-90. Integration of park base, entrance fees, and science base monies will be important in order to resolve the major issue of restoring cultural landscapes and controlling/eliminating noxious weeds. Once the effects of Gramm-Rudman are identified, a work plan will be developed. It was recommended that efforts be concentrated on the current research programs rather than broadening, thereby diluting the overall program. Full treatment of the workshop will be carried in the Spring issue of *Park Science*.

Western Region

For the fourth time in eight years, the annual update of Hawaii Volcanoes NP resources management plan was kicked off by a workshop attended by 40 lay critics, university and institution scientists, interagency land managers and NPS scientists and managers. The workshop, held Oct. 22 and led by HAVO Resources Management Chief Dan Taylor, was in round-table discussion format and preceded by distribution of briefing papers on the Park's natural resource management and research programs and a list of potentially controversial issues. Participants discussed issues and critiqued the Park's performance and proposals. HAVO staff will assimilate comments into the 1988 update of the RMP.

* * *

A conservation education workshop, "The Conservation of Island Ecosystems through Interaction of Educators and Interpreters, Natural Resource Managers, Researchers, Administrators, and Other Groups," brought together approximately 60 Service and non-Service participants on Nov. 2-6. The workshop was organized by Dr. Charles Stone, Research Scientist at Hawaii Volcanoes NP, and held at the Kilauea Military Camp at Hilo. NPCA's Destry Jarvis gave opening remarks.

* * *

Earlier this year, Dr. Clifford Smith, Unit Leader of the CPSU at the University of Hawaii, led a team of two NPS scientists and a University of Guam biologist to help staff of War in the Pacific National Park strengthen their natural resources management plan. The team worked with the staff to identify and prioritize resource issues and to prepare new project statements to be incorporated into the next plan update.

* * *

Approval has just been received from the Hawaii State Department of Agriculture and the U.S. Department of Animal, Plant and Health Inspection Service to release the first biological control agent in Hawaii. The agent is a moth whose larvae feeds on the leaves of banana poka, the highest priority weed pest in the Islands. The evaluation and screening research leading up to the approval was conducted at the Hawaii Volcanoes NP quarantine facility under an NPS/USFS/State of Hawaii interagency agreement. Banana poka is a passion fruit vine that smothers most other vegetation, even the largest trees, forming monotypic stands over hundreds of acres.

* * *

Dr. Donald Gardner, Research Scientist at the University of Hawaii's CPSU, led a team of three scientists to the Azores and Canary Islands in June 1987, to further study natural enemies of the faya tree. Three potentially useful insects and two fungi were brought back to Hawaii for further biocontrol research in the quarantine facility at Hawaii Volcanoes NP. The faya tree was introduced to Hawaii for reforestation at the turn of the century. In the last 30 years, it has rapidly invaded Hawaii Volcanoes NP and is a threat to Haleakala NP. It ranks as the second highest priority weed management problem in Hawaii's national parks.

The Regional Director's Natural Resources Advisory Group (four resource managers and three research scientists) met with the staff of the Western Regional Office's Division of Natural Resources and Research on Oct. 27-29. Items of discussion included updating natural resources management plans and the regional natural resources assessment and action plan, a definition of natural resources management,

Water Quality Workshop Held at Olympic NP

Measurement of pH, conductivity, and alkalinity is fundamental to most studies of water resources. Yet, accurate measurement of these parameters, particularly of pH, is not simple in low-ionic strength waters. Waters of upland streams and lakes in the Pacific Northwest generally have very low solute concentrations (i.e. are "pure" waters). In these waters, errors in measurement of pH of 0.10 to 2.00 pH units are common using traditional techniques. These errors may seem of no consequence until one recognizes that pH is a logarithmic scale, representing the negative log of hydrogen ion activity. Thus, a small change in pH (0.10 pH unit) reflects a large change in hydrogen ion concentration (26% error). In national parks, achieving accurate results in pH measurement is important, particularly in establishing baseline conditions.

In September, 1987 a 2-day workshop on the measurement of pH, conductivity, and alkalinity was held at Olympic NP, led by Dr. Richard Metcalf, a Senior Geochemist in the Acid Deposition Department, Lockheed-EMSO. (Lockheed is under contract to EPA for the National Surface Water Survey, Episodic Response Project, and Watershed Manipulation Programs).

Attendees were from the large, natural area parks in the region, the Pacific Northwest Regional Office, CPSU at Oregon State University, Water Resources Branch in Fort Collins, and Washington State Department of Ecology. Topics covered included the theory and practice of pH measurement (types of electrodes, liquid junction potential errors, stirring potential errors,

use of dilute standards), applied conductivity measurements, determination of alkalinity, QA/QC, and hints on evaluating water chemistry research or contract work.

In an afternoon session, participants, using their own field pH meters, measured an unknown solution having a pH not revealed until the experiment's end. Results of this experiment are shown in Table 1.

The "mystery" solution was $1.00 \pm 0.01 \times 10^{-4}$ M HCl, with a pH of 4.005 at 25°C. For this solution, uncalibrated liquid junction potential errors cause a change in the value the electrode should read to 4.06 at 25°C. The experiment illustrated the importance of careful choice of equipment, and strict attention to methodology. It also made clear the need for "enlightened" evaluation of current and past research results. The trial indicated that no agreement closer than ± 0.16 pH unit should be expected (45% error in hydrogen ion concentration) for different people measuring the same water!

As a result of the workshop, water quality monitoring programs in the Pacific Northwest Region will be evaluated for appropriateness of equipment, field, and lab methodology. Meaningful, accurate results in the measurement of pH, conductivity, and alkalinity should be the end product in these parks.

For further information on this topic, contact Cat Hawkins, Olympic National Park, 600 East Park Avenue, Port Angeles, WA 98362 (FTS 396-4501; Comm 206-452-4501).

Cat Hawkins
Natural Resource Specialist

Table 1
pH Reading, Three Measurement Trials

Individual or team	Trial 1	Trial 2	Trial 3
A	3.93	3.85	3.82
B	4.03	4.02	4.02
C	3.98	3.99	4.00
D	4.09	4.07	4.08
E	4.36	4.05	4.03
F	4.02	4.07	3.97
G	4.01	3.96	3.99
mean	4.06	4.00	3.99
2 std. dev.	0.28	0.16	0.16

Regional Highlights

Continued from page 14

aircraft management, the region's rotating resource base and natural resource cyclic maintenance funding programs, and the relationship between natural resource management and the Service's Maintenance Management System.

* * *

NPS and USFS have completed a draft joint plan to manage the Caldwell Cougar Butte Communal Bald Eagle Roost in and adjacent to Lava Beds National Monument. The draft recommends that the agencies maintain current timber stand overstory characteristics and ensure long-term health, regeneration and recruitment of Ponderosa pine into the overstory, thus providing suitable winter roosts in the future for approximately 50-90 of the 500 bald eagles that winter in the Klamath Basin. The draft also recommends the use of hazard fuel reduction in and around the roost and the minimizing of human disturbance during the

winter roosting period.

On Oct. 19-20, Steven Underwood, Resource Manager at Lava Beds National Monument, led a minisymposium on the park's prescribed fire management program. Three NPS scientists, one U/Cal scientist, and a retired USDA scientist met with park staff and local state Fish and Game Department personnel to review the park's ongoing prescribed fire program and its impact on native wildlife and non-native plants. They concluded that the program was "on track," but identified and discussed further research that would benefit the prescribed fire program.

* * *

Recent publications related to parks in the Western Region:

"Vegetation of the Bald Hills Oak Woodlands, Redwood National Park, California," (Neil Sugihara, Lois Reed and James Lenihan), **Modrono**, July-September.

"Mycorrhizal associated with an invasion of *Erechtites glomerata* (Asteraceae) on San Miguel Is-

land, California," (William Halvorson and Richard Koske), **Modrono**, July-September.

Food Habits of Feral Burros in Death Valley, California, Charles Douglas and Hermi Hiatt, CPSU University of Nevada Technical Report, August 1987.

Vegetation Recovery Following Livestock Removal Near Quitobaquito Spring, Organ Pipe Cactus National Monument, Peter Warren and L. Susan Anderson, CPSU University of Arizona Technical Report No. 20, January 1987.

The Status of Native Flowering Plant Species on the South Slope of Haleakala, East Maui, Hawaii, A.C. Medeiros, L.L. Loope, and R.A. Holt, CPSU University of Hawaii Technical Report No. 59, July 1986.

History of Endemic Hawaiian Birds, Part 1: Population Histories - Species Accounts; Forest Birds: Maui Parrotbill, 'O'u, Palila, Greater Koa Finch, Lesser Koa Finch and Grosbeak Finch, Winston Banko, CPSU University of Hawaii Avian History Report 10, December 1986.

History of Endemic Hawaiian Birds, Part 1: Population Histories - Species Accounts; Forest Birds: 'Apapane, 'Akohekohe, and 'Uha'iahawane, Winston Banko, CPSU University of Hawaii Avian History Report 11a, July 1987.

* * *

Lloyd L. Loope and Charles P. Stone are co-authors with Peter M. Vitousek of an article on "Introduced Species in Hawaii: Biological Effects and Opportunities for Ecological Research" in *Trends in Ecology and Evolution*, July 1987, Vol. 2, No. 7, pp. 224-227. The article examines Hawaiian islands' role as "perhaps the most extraordinary museum of evolution on the planet" - under pressure from introduced alien species and from habitat destruction but providing, at the same time, a dynamic laboratory of ecological processes.

Loope and Arthur C. Medeiros, both of Haleakala NP, are represented in the *Journal of Tropical Ecology* (1987, 3:169-170) by an article on "Introduced vespids (yellowjacket wasps) that prey on Maui's endemic arthropod fauna." Co-author is Parker Gambino of U/Cal, Berkeley's Department of Entomological Sciences.

Southeast Region

The National Academy of Sciences submitted a 24-page interim report, *Options for Preparing the Cape Hatteras Lighthouse: Interim Report to the Southeast Regional Office*. The report suggests that moving the 117-year-old, 208-foot brick lighthouse is the best long-term protection option. Other options evaluated involved a seawall revetment, rehabilitation of a groin field, rehabilitation of a groin field with a partial revetment, sinking ships offshore, offshore breakwaters and groins, artificial seagrass and beach nourishment.

* * *

The final revised recovery plan for the Florida panther was approved and is available for distribution. The recovery plan was a joint effort of NPS, USFWS, Florida Department of Natural Resources, and Florida Game and Fresh Water Fish Commission.

* * *

Legislation recently was introduced to deauthorize NPS and USFWS lands (Cape Hatteras National Seashore and Pea Island National Wildlife Refuge) at Oregon Inlet, NC, so that the Corps of Engineers can proceed with construction of two large jetties to stabilize the inlet. DOI continues to oppose the project based on the potential for environmental damage. NPS Southeast Regional Office has received an up-

letters

To the Editor:

As coordinator of research at TVA's Land Between the Lakes National Recreation Area, I find *Park Science* very informative. . . . As you may know, National Recreation Areas are spread across three federal agencies. The U.S. Forest Service manages 11 NRAs, TVA manages one, and NPS manages 17. An additional one is managed jointly by NPS and the USFS. It seems there is a need for sharing information among NRAs. I would be interested in knowing how many of the 11 Forest Service NRAs are on the mailing list for *Park Science* and I am enclosing a list of them in case you may wish to add them to your subscription list.

If you have any suggestions for the sharing of information among NRAs, let me know. I think NRAs are as important to the nation as national parks. A case in point is that in 1985, national parks received 50 million visitors in 48 parks on 45 million acres, while NRAs received 49 million visitors in 17 parks on only 3 million acres (NPS statistical abstracts - 1985, Denver Service Center). This equates to nearly three times as many visitors per park and 15 times as many per acre in NRAs compared to national parks.

Certainly this presents enormous problems for NRA park managers, researchers, and planners. For this reason, I think it behooves NRAs in some ways to come together to share ideas and information. It may even be worthwhile to consider calling a national meeting of NRA administrators to discuss this matter. What do you and your readers think?

Also, I am interested in submitting a one-page article to *Park Science* on research at LBL, provided you think it is an appropriate place to publish such an article.

Thomas D. Forsythe, Coordinator
Research Development
Land Between the Lakes, TVA
Golden Pond, KY 42231

Joint US-USSR Research Proposed For Beringian Sites

Eighteen months of cabled exchanges between the U.S. and the Soviet Union culminated June 19-July 24, 1987, in a trip to the USSR and Poland by a six-member U.S. delegation and could lead, eventually, to establishment of a Beringian Heritage Conservation and Management project. A Russian team completed the exchange by visiting the U.S. in October.

Headed by Denis P. Galvin, NPS Deputy Director, the U.S. team was composed of three others from the National Park Service - Richard Cook, Division of International Affairs; Robert Chandler, Olympic NP superintendent, and William Brown, Alaska Regional historian, plus Destry Jarvis, vice-president of the National Parks and Conservation Association, and Dale Guthrie of the University of Alaska.

"As a result of talks with the Russians when they were here in October," Cook said, "we anticipate as our near-term objective a series of joint studies leading toward possible park designations on both sides of the Bering Strait and an international designation of two or more sites to commemorate the international significance of the Bering Land Bridge."

The longer range objective would be to foster collaboration on studies relating to research and conservation of Beringian sites in Siberia and Alaska and eventual establishment of an International Beringian Peace Park on both U.S. and USSR territory.

Cooperative and shared studies by the two nations already have confirmed the shared resources and the indissoluble ties between the Beringian segments of Siberia and Alaska in all major fields of earth, biological, and anthropological sciences, Cook pointed out. Established and monitored reserves of various kinds already exist on both sides of the Bering Strait and bilateral agreements are in effect relating to migratory birds and sea mammals.

Once the results and recommendations of the first-stage study were ratified by the two nations, a carefully designed series of scientific studies and evolved management techniques could be developed and implemented.

"To encourage the further gathering of scientific data and development of derivative conservation and management policies to the benefit of both nations, the proposal states, "this project might initially field a

joint, broad-scope scientific team to inventory, evaluate, and recommend a system of representative sites and zones suitable for Biosphere Reserve designation, with a mutually defined geographic framework adequate for the purpose."

The exchange trips and their follow-up were made under the general auspices of the Joint U.S.-USSR Agreement on Cooperation in the Field of Environmental Protection. The Soviet and U.S. teams, on their exchange visits, took part in seminars on design, organization, and management of the national parks in both countries.

Archeological Research Bares Prehistoric Past

Archeological researchers in Canyonlands NP and Glen Canyon NRA have recently documented an intense and almost continuous Archaic Period occupation in southeastern Utah dating from at least as early as 8,600 radiocarbon years ago until the time of Christ. Around 3,500 years ago, these groups camped on shores of now extinct lakes and used the plentiful associated resources in what are now steep-walled, slickrock canyons. The rare presence of post-Pueblo Period brush structures dating to AD 1400 also has been documented.

In conjunction with this archeological research, Northern Arizona University's Quaternary Studies Unit (Department of Geology) headed by Dr. Larry Agenbroad has been working with NPS to reconstruct the Holocene environment. This will help us understand prehistoric occupational patterns and uses of the Canyonlands country. As an ancillary result of these efforts, the presence of Harrington's mountain goat (*Oreamnos harringtoni* Stock), mammoth (*Mammuthus*), Yellow-bellied marmot (*Marmota flaviventris*), ground sloth (*Nothrotheriops*), camel (*Camelops*), and shrub-ox (*Eucatherium*) has been well established in terminal Pleistocene contexts in the Southern Utah parks. It also has been established that alluvial sediments remain in the canyons that date back at least 40,000 years and include the rare Pleistocene/Holocene boundary.

Draft Prehistoric Ruins Stabilization Plans, documents comparable to Historic Structures Preservation Guides, have been completed this fall for Canyonlands, Glen Canyon, and Natural Bridges National Monument through multiyear ruins stabilization programs. These are the first such NPS plans developed in conjunction with the preservation maintenance required to protect the nearly 100 sites that have been stabilized.

Archeological and paleontological test excavations carried out this past summer in Wind Cave NP produced evidence of an unbroken stratigraphic record of the Holocene from about 1,500 to 10,000 radiocarbon years ago - a first for the Black Hills area. The most intensive human occupation of the rockshelter appears to be from 3,500 to 6,000 years ago. Deeper deposits believed to represent an early Archaic component have yet to be dated.

Bob Schiller
Asst. Chief Scientist
Rocky Mountain Region

Regional Highlights

Continued from page 15

dated contract report from Dr. Douglas Inman, Scripps Institution of Oceanography, analyzing the Corps' latest designs and the potential impact on shoreline processes.

* * *

The Department of Navy has agreed to provide \$4.8 million to monitor the impact of the U.S. Navy's Kings Bay construction and dredging program on Cumberland Island National Seashore. The dredging associated with the project is expected to remove 70 million cubic yards of sand. The science program of the Southeast Region is working cooperatively with the Navy, Corps of Engineers, Fish and Wildlife Ser-

vice, and States of Georgia and Florida to develop a 5-year environmental monitoring program for the area. The program will include geological, biological, hydrological, and mitigation components.

* * *

The University of Miami, in cooperation with NPS, is sponsoring a workshop on coral reef degradation at Virgin Islands NP. A team of coral reef scientists will meet at the new National Park Service Conference Center on St. John to examine causes of reef degradation and techniques for rehabilitation. Key information will be compiled in a guidebook for managers of protected areas.

Ecological Studies Of Sunken Forest

By Mary K. Foley

Maritime forests are unique communities that develop in secondary dune ridges where they are protected from salt-laden oceanic winds and waves. The Sunken Forest is a well-known maritime forest composed predominately of American holly (*Ilex opaca*), white sassafras (*Sassafras albidum*), and shadbush (*Amelanchier canadensis*) and the largest (16 hectares) of those is found on Fire Island, NY, within Fire Island National Seashore.

The Sunken Forest owes its continued existence to a combination of autogenic and allogenic factors affecting the development of the Forest over the past several hundred years. Severe storms causing overwash, inlet migration, sand deposition and erosion, salt injury, fire and animal-browse – all are examples of disturbances that affect maritime forest development and are believed to be vital to the long-term maintenance of the Sunken Forest (Art, 1976; Backman and Patterson, 1986; Art, 1987).

In recent years the Sunken Forest has become a popular site for park visitors with interpretive walks conducted several times a day during the summer season. Visitors walk through the Forest on raised, wooden boardwalks to protect the area. However, the numbers of visitors leaving the boardwalks to explore the darkened forest and to climb the secondary dune structures has increased. This, combined with an overpopulation of deer, has raised a concern that natural regeneration and, hence, the long-term reproduction of the holly-sassafras-shadbush community may be restricted leading to a gradual increase in catbrier (*Smilax* sp.), poison ivy (*Rhus radicans*) and other lianas.

A thorough understanding of the importance of these factors to the continued development of the Forest is essential to insure that the natural processes which maintain it are not inadvertently altered. As it is believed that long term maintenance of the Forest depends on the occurrence of disturbances, the NPS initiated an investigation into the reproductive patterns of the Sunken Forest and an assessment of the impacts of disturbances such as deer, hurricane Gloria, rising sea levels, fire, and visitors.

In 1967, as part of his Ph.D. dissertation research, Dr. Henry Art analyzed vegetation through the establishment of 34 permanent vegetation plots in the Sunken Forest to determine the influence of meteorological nutrient inputs on the structure and function of maritime forest ecosystems (see NPS Management Series, No. 7, 1976). In 1985 and 1986 Art returned to the Forest to resample these plots to determine the pattern of succession since 1967 and to investigate the possible causes of change over the past 20 years.



Hurricane Gloria packed a measurable wallop when she plowed into the Fire Island NS's Sunken Forest on Sept. 27, 1985. (Photo by James Northrup, Grand Tetons NP).

Art was able to relocate 19 of the original 34 plots, observing after this first resampling that, although the deer population in the Forest has increased dramatically since 1967 from very low numbers to approximately 200 to 400 individuals by the mid 1980s, this increase has had little effect on the dominant species of the tree layer. However, Art believes that deer may be a major cause of the reduction of subordinate tree layer species such as *Ilex glabra*, *Vaccinium corymbosum* and *Gaylussacia baccata* in the shrub layer and herbaceous perennials such as *Aralia nudicaulis* and *Smilacina stellata*. Deer exclosures have been constructed around several of the permanent plots to verify that the reduction in these species is related to deer and not simply a successional response.

Another influence is related to changing ground water conditions. One plot was lost and another partially lost due to encroaching brackish water causing a transition from forest to marsh on the bayside of the island. Three other plots have dying trees attributable to encroaching salt water.

Also, on Sept. 27, 1985, hurricane Gloria (rated between a class 1 and class 2 hurricane on the Saffir-Simpson Hurricane Damage Potential Scale) passed over Fire Island with winds of 70-90 mph and gusts in excess of 90 mph, presenting a rare opportunity to evaluate the impact of severe storms on northern maritime forest dynamics. Although Gloria was responsible for uprooting many trees in the Forest, Art reports that the storm was far from devastating. Increases in overall basal area and density compen-

sated for the initial storm-induced mortality. The storm also appears to have stimulated growth in the shrub layer and recruitment of woody seedlings in the herbaceous layer.

These studies will continue in the Sunken Forest to quantify ecosystem effects and to examine other forest disturbances. For example, pollen and charcoal analyses by Backman and Patterson (1984) from bog samples from the Forest suggest that fire may be an important disturbance factor. Next spring two plots will undergo prescribed burns to develop more data on the response of this forest community to fire. Also, additional plots will be established in high visitor use areas. We hope to gather enough information about the dynamics of the forest to guide managers in the protection of this unique community type.

Foley is a Forest Ecologist in the North Atlantic Regional Office.

References

- Art, Henry W., 1976. *Ecological Studies of the Sunken Forest, Fire Island National Seashore, New York. National Park Service Monograph #7, 237p.*
- Art, Henry W., 1987. *Patterns of Community Dynamics in the Sunken Forest: 1967 to 1985 and 1985 to 1986. NPS/OSS Technical Report, June 1987.*
- Backman, Andrew E. and William A. Patterson, III, 1986. *Fire and the long-term development of the Sunken Forest at Fire Island, New York, in: Fire Regimes of Fire Island National Seashore, NPS/OSS Technical Report.*

Task Force Coordinating Science Pubs

A cohesive, Servicewide science and natural resources publication program is the goal of a new project headed by NPS Natural Resources Publication Coordinator Donna O'Leary and based on a proposal she presented to the Regional Chief Scientists at their August 1987 meeting at Glacier NP.

A publication task force, chaired by O'Leary, is reviewing and evaluating all current publications. The group met in Denver on Nov. 18 and 19 to determine what publications should be included in the overall program; to develop peer and management review

procedures; to standardize report formats, series names, and numbering; to determine essential editorial and printing services; to create a publication editorial board; to provide document distribution services, and to create and maintain a bibliographic database.

Task force recommendations growing out of the November workshop will be circulated to the field, O'Leary said, "to insure their applicability and acceptance, and to enable field personnel to remedy any sins of omission or commission."

In addition to O'Leary, task force members are Dr.

Charles Van Riper III, CPSU scientist at the University of California, Davis; Dr. Milford Fletcher, Southwest Region Chief Scientist; Sandra Key, Bryce Canyon Superintendent; Meg Weesner, New River Gorge Resource Manager; Nora Mitchell, North Atlantic Region Resource Manager; Jim Wood, NPS Science Publication Office editor.

O'Leary is on staff to the Associate Director, Natural Resources, and based in Denver. Her mailing address is c/o Air Quality Division, P.O. Box 25287, Denver, CO 80225-0287; FTS 327-2156, (303) 969-2156.

Strategic Management Needed To Maximize Park Resources

Editor's Note: Following is part of the presentation made by Asst. Supt. Robert L. Arnberger of Everglades NP to the June 3, 1987 superintendency course at Delaware Water Gap. The full paper, which discusses the need for NPS superintendents to abandon the old "custodial" approach and to embrace "strategic management" will appear in a forthcoming issue of the George Wright Society's FORUM (Vol. V No. 4 1988). In the full article, Arnberger examines the societal and environmental pressures that have led to the need for a new strategic approach to park management and he details the legislated imperatives that demand this new kind of superintendency. Presented here are Arnberger's suggestions for how NPS superintendents can adapt to the changing needs of the National Park System and maximize the usefulness of park resources and the knowledge they engender.

When the park manager enters the decision role, success will largely depend on the manager's ability to: (1) establish clear objectives; (2) anticipate potential impacts; (3) find help to support park interests; (4) understand the planning and regulatory process; (5) make some compromises consistent with park purposes; (6) follow through on promises.

The mechanics of problem identification, solution, and community involvement are as varied as the number of parks, managers, and situations. Realizing this, I hope to weave for you a fabric of insights I have gleaned from the following sources:

1. Essay by Roland Wauer on "The Role of the National Park Service Natural Resource Manager," February 1980;

2. Essay and presentation by Rick Smith on "Some Non-Ecological Principles," December 1981, later printed in *Park Science*, Winter 1984;

3. Draft Report on "Park Protection" by WASO based upon interviews with superintendents and members of their staff in 15 parks heavily affected by development pressures on adjacent lands, March 1987;

4. Essays and presentations on "The Politics of Resource Management at Saguaro National Monument," by Robert Arnberger, April 1986.

This fabric is heavily textured by my own feelings and experiences. It does not reflect the only way to do something. You may take issue with my perceptions. Your reactions are every bit as valid as mine and these other authors.

Proposition I

Have a clear understanding of what the *real* issue is and what the NPS position is. A superficial understanding of the issue is quickly perceived and the credibility of data or founding philosophy can be irretrievably impaired.

Corollaries to consider:

1. Recognize that a legislative and administrative history of a park is based upon a series of promises, deals, trade-offs, and compromises required to garner support for the project. Don't make a fatal mistake of ignoring them, but examine them in a *positive* light relative to the *opportunities* they offer.

2. The NPS should present its own interests and desires independently and avoid joining "coalitions." It seems to me too easy to have a coalition, rather than the superintendent, dictating what is best for the park unit. As well, a coalition can mix the primary issue with secondary special interest issues that end up confusing and confounding those that must resolve the issue. By not "joining the party," you may be tagged as a "fence sitter." Combat this perception aggressively by repeatedly speaking to NPS interests and stressing the need for the independence of your action. Alliances differ from coalitions and are a neces-

sary fact of life. Realize that the ally you have today may be your adversary tomorrow. Seek strong alliances based upon philosophical and practical similarities. The weakest alliances are exclusively issue specific and any similarity of philosophy or mission is coincidental. Beware of the "wolf in lamb's clothing" who wishes to seek an alliance for other purposes.

3. Avoid confusing friends and foe. Exercise well-thought-out "battlefield tactics" but don't let such maneuvers confuse those who hold the key to solution. When the question is asked, "I wonder what side he is on now?", answer it aggressively and consistently with, "the resource's side." Frequently, issues get clouded by the variety and number of community groups involved. Separate out the NPS issue and deal in a clear-cut manner with those issues that impact the resource *you* manage. Dealing with other issues can weaken your position.

Proposition II

A community must possess a sense of investment in the positive solution of problems. Park problems are community problems and solutions must be perceived as having their origins in the community rather than within the park.

Corollaries to consider:

1. The "people" process differs from the "political" process. Developing a sense of investment in these two groups may bring you to the same final product but is usually a result of different processes. A politician's sense of "investment" may be edged with hard realities and compromises. The "people's" sense of investment may be one of emotion and philosophy lacking a great deal of practicality.

2. Special interest groups will assent to investment or agreement *only* when they are convinced that their *own* interests are being served. Philosophical arguments generally will be futile. Concentrate on determining that *they* will gain rather than what the park will gain.

3. Market your park as an integral and vital member of the community. Know the demographics of your visitation and the economics that your presence in the community represents. Speak to how the park contributes to local employment, citizen enjoyment, emergency services, visitor dollars, and "national image" for the community. Build a constituency actively and purposefully.

Proposition III

Know the game players and be well versed in the rules by which *they* must play, for those are the rules you must play by also. Get involved early and watch and listen carefully as the issue begins to develop. Chart not only your own progress in the issue, but that of others as well. Knowing what was said in preliminary meetings and knowing the dynamics of the participants may directly influence the outcome.

Corollaries to consider:

1. The administrative and legal process by which a community plans and leads itself will be even more important for you to learn than the similar process in your own agency. Read the comprehensive plans, the zoning ordinances, transportation plans, and neighborhood plans. Know what the planner's positions are, know what the politicians feel, and know what the special interest groups want. Knowledge of the process and personalities is the best tool for predicting behavior.

2. Don't be accused of "not coordinating" and don't be a stranger to the key agency orchestrating the process. Pursue "official coordination" responsibilities but don't forget the regular informal visit to discuss a mutual issue or find out more about an issue. Remember the reality of coordination – once you start, be sure you *fairly* involve yourself in the full spectrum of the issue – with both friend and foe.

3. Recognize that other points of view may be valid and try to understand the interests of other participants. While being concerned about impacts on parks, don't fail to recognize that the park sometimes produces negative impacts on adjacent landowners. Respect other's interests – even if we may not agree with them. Be "up front" in your disagreement and realize that "too much bobbing and weaving can lose you the prize fight."

Proposition IV

It is possible to make decisions based upon philosophical considerations and they will be accepted if you are honest about it. However, there is no substitute for accurate science data to combine with the philosophical consideration. Decisions are based on a variety of facts and information and should not be subject to exclusive subservience to scientific data or required research. You won't often get away with a philosophical or emotional decision, so be sure you take your best shot. Ultimately the data will be asked for or required anyway.

Corollaries to consider:

1. "Crying wolf" will work twice – not three times. Even your friends will desert you when you present arguments that have little substance. Substance and strength lie in facts, data, more facts, and more data. If you are making a decision based upon few facts, then say so. Creation of data and presentation of irrelevant facts are quickly detected.

2. Prepare to be challenged with every decision. Before making the decision, institute a process of evaluating what the challenges may be and where they will come from.

3. Deal with specific impacts upon a specific resource; your arguments will be more persuasive than appeals to the general principles of conservation.

4. Expect to have the rug pulled out from under you. Develop fall-back positions and be prepared to negotiate. Distinguish between what is *essential* to protect the park and what is merely desirable. Know how to conduct an effective damage control mission and be able to distinguish when you have done enough. Too much damage control purveys a sense of weakness and lack of planning.

Proposition V

The solution to a problem is not necessarily dependent on NPS assuming the leadership role. Plan your strategy to determine levels of involvement and what opportunities exist to deliberately avoid or engage involvement.

Corollaries to consider:

1. Sometimes "your" statement can be more effectively said by someone else. Realize that others can be leaders too, and may carry the banner more ably than you. Don't avoid behind the scenes maneuvering and action in order to ensure that resource interests are protected. Realize that a variety of avenues can lead to a common goal.

2. The political and special interest friends of the park must be alerted and prepared to play a part in the solution of highly charged political issues. Park managers must be able to recognize the point after which they can do no more. Third party interests must be similarly astute in recognizing this impasse point and be prepared to exercise the opportunities available to them.

3. Beware of the "Joan of Arc" complex. She commanded an army, but she was burned at the stake. Our own egos sometimes lead us into roles we should not accept. Coalitions looking for either leaders or scapegoats constantly search for that "magnetic issue and personality." Remember that generals manage their battles from war rooms at the rear of the front. Victory usually is achieved by a variety of field commanders who follow a strategy developed by the general.

4. Be persistent and patient. Some of the success stories are the result of efforts by park managers who have pursued their objective against heavy odds. The time and energy invested in endless meetings may not produce immediate results, but they build credibility and may lead to a key decision that will protect the park. There are a lot of friends out there - your job is to make contact with them.

5. Remember, you aren't the only one planning involvement or action strategies. Just as you incorporate others into your agenda without their knowledge, they are doing the same with you. As you manipulate the process and the personalities within the process, realize you are probably being manipulated by others. Be prepared to react when someone else's agenda maneuvers you into a position where you don't wish to be. Similarly, be prepared to react and seize the opportunity when someone else's agenda has maneuvered you to "where you want to be."

Each park manager will find his or her own niche in the politics of community resource management program. Each manager will develop a personal style and form in dealing with the community. I simply contend that your entrance into the community must be a conscious decision. It begins with a personal philosophical orientation to *take* action rather than have it forced upon you. It recognizes that remedy is intimately linked to community politics. It requires a park manager to be more than a "Custodial Superintendent." It involves accepting a strategic management role that allows maneuvering in fluid and value laden political environments where the variety of legislative, administrative, and policy remedies can be used more decisively to protect the resource.

A new concept of conservation biology also must evolve, to better respond to the realities now being faced by our parks. This will allow a manager the flexibility of dealing with issues and making strategic decisions based on less than the ideal empirical evidence, concentrating on systems and entire biological communities. Ultimately philosophy, legislation, a new biology and strategic management is translated into mechanical field applications by the park superintendent.

Oral Bait Acceptance Research In D.C.'s Rock Creek Park

By John Hadidian

A wildlife rabies outbreak, thought to have originated in the western counties of Virginia and West Virginia in 1977, reached the metropolitan Washington, D.C. area in the fall of 1982. Although primarily affecting raccoons, this epizootic spilled over into other wildlife species that commonly inhabit the urban National Parks of the nation's capital, such as fox, bats, opossum, and woodchucks.

As cases began to be reported it was known that the outbreak would pose a genuine threat to humans, and that both immediate and long-term concerns for public health and safety in affected areas would have to be addressed. Such concerns, as well as others related to resource protection, were raised early in the National Capital Region (NCR).

With a concentration of urban parks in NCR the interaction between wildlife and humans is often intensive, and the potential always exists for wildlife and human health problems to be shared. Because of this, Regional Director Jack Fish determined that planning should begin to facilitate basic information collection concerning raccoon ecology, population dynamics, and rabies epizootiology. Rock Creek Park (ROCR) was selected as the study area, and David Manski, now a Resource Management Specialist at Aniakchak National Monument and Preserve, began a cooperative research project involving the University of the District of Columbia, the National Zoo, D.C.'s Department of Public Health, and the Centers for Disease Control in Atlanta.

In addition to collecting baseline data, the study was intended to identify concerns NCR would face in coming years with the expected continued presence of the disease. Much of the data collected are still being interpreted, but preliminary findings have been used to form the basis of a program of applied, management-oriented research intended to address specific questions about the interaction between raccoons, people, and rabies. This research has been coordinated with projects underway in adjoining states to provide a broader perspective to park managers

on issues they likely will face concerning the raccoon population.

Disease Marches North

Perhaps the most important issue with regard to the Mid-Atlantic Raccoon Rabies Outbreak (as it is now known) is whether the disease can be stopped or slowed before further spread into unaffected areas. Since 1983, movement northward has been inexorable, and rabies is now north of the Susquehanna River and into Pennsylvania. Public health officials in New Jersey and New York see it as only a matter of time before their states are affected, and there are no apparent barriers to prevent further spread of the disease. Where the rabies epizootic has already occurred it appears to be persisting in an endemic status, which further encourages questions about eradication.

Only two methods are presently known by which rabies-free areas can be created. One is immunization through vaccination, as we do cats and dogs. The other is population reduction through trapping and killing animals or otherwise reducing population densities below the level at which rabies can be sustained. Numerous impracticalities of population reduction in rabies control have been documented, such that this method is not advised except as a last resort in cases where control is absolutely mandated.

Impracticalities also exist concerning immunization, however, and these have long constituted roadblocks to rabies control in wild populations. To be effective, most wildlife rabies vaccines must currently be administered by injection. The difficulties of catching and immunizing a large enough segment of a wild population to protect against spread of the disease are considerable. Only in areas that have special geographical features, such as the narrow isthmus on the Delmarva Peninsula between Maryland and Delaware, can such procedures be attempted.

Continued on page 20



Oral bait package in the field - blends with urban garbage.

Oral Bait in D.C.

Continued from page 19

Promising Programs

More promising are programs such as those now being conducted in both Europe and Canada to immunize red fox against rabies by using ingestible, or oral, baits. In these, orally active vaccines are loaded into a suitable medium or bait package, coated with an attractant, and dropped in large numbers over an area, usually from the air. The attractant draws the "target" animal's attention to the bait, which, when eaten, has the effect of immunizing against the disease. The major drawback to this procedure has been the development of effective oral vaccines. Recent advances in medical technology, however, are beginning to surmount that obstacle, and, in the near future, promise to make vaccine production speedy, less costly, and highly specific as products are tailored to individual species.

Once a vaccine is available, there still remains the complex task of delivering it. Details of bait density and placement, time of year, activity of target species, choice of attractants, and many other factors must be worked out. It was to test these and other factors related to bait acceptance in urban raccoons that a cooperative study was conducted in the summer of 1986 in Rock Creek Park with the Centers for Disease Control in Atlanta, the Southeastern Wildlife Disease Cooperative Study, the Ministry of Natural Resources in Ontario, Canada, the Virginia State Department of Health, and the USDA Animal and Plant Health Inspection Service (APHIS) unit in Denver, Colorado.

Bait Packages

Using methods tested already in European and Canadian studies, and also being used in two undeveloped areas in Virginia, a thousand bait packages were prepared for distribution in a 200 acre (80 hectare) study area in Rock Creek Park. Each bait package consisted of three things: (1) a plastic bag, perforated with small holes and stamped with a message identifying the contents and the purpose of the study, (2) the bait itself, a wax-coated sponge cube with a placebo vaccine mixture injected into the sponge matrix, and (3) the attractant, a slurry made of commercially available canned mackerel that had been used with success live-trapping raccoons in the past.

Each bait also contained a small amount of iophenoxic acid (IA), a substance which has been found to be an excellent biological marker, causing an elevated blood iodine level to appear in animals that ingest it. This seromarker was chosen instead of the more usual biomarker, tetracycline, because the use of tetracycline necessitates the removal of at least one tooth from each subject, while a simple blood sample will suffice to identify the presence of IA.

The baits were dropped along preestablished lines by volunteers, and left out for a period of three weeks. Following the bait-out period, live-trapping began at 15 locations and was continued for two weeks. Trapped raccoons were examined and bled, and serum samples were assayed in Denver for blood iodine levels. By determining how many of the trapped raccoons had taken baits it would be possible to estimate whether sufficient protection would have been given to the population had a vaccine been used, rather than the seromarker.

Results Encouraging

The results obtained were encouraging. Fifty-three raccoons were trapped from the study area in a ten-day period, and blood was obtained from 52. Of these, 33 (63%) had elevated blood iodine levels indicating

Ecosystem Management for Parks and Wilderness Report of the Workshop

By James K. Agee

Park and wilderness managers face significant challenges and opportunities in the stewardship of park and wilderness resources for present and future generations. To develop an improved conceptual approach to managing change in parks and wilderness, a workshop involving 33 scientists, planners, and

managers was held in April, 1987, at the University of Washington's Pack Forest near Mount Rainier. Participants included ten people from NPS and six from the Forest Service, with the remainder representing various academic disciplines from across the country. The report of the workshop, summarized here, will be available in January, 1988.

The workshop focused on cooperative approaches to park and wilderness ecosystem management. Understanding change, and sometimes unpredictable change, is an essential part of understanding how these systems function. Because parks and wildernesses are non-equilibrium systems, management strategies must deal effectively with uncertainty.

Successful management of uncertainty involves: (1) defining goals and measurable targets for ecosystem condition; (2) defining boundaries for components of priority concern; (3) developing management strategies which recognize that issues will transcend political boundaries; and (4) establishing a program to monitor the strategies chosen. Nine principles of ecosystem management are discussed, as well as the advantages and disadvantages of structures (formal) and unstructured (informal) approaches to ecosystem management. Top priority issues are identified in four areas. Three common themes emerged from the prioritization process:

There is a need to define precisely the management objectives for park and wilderness lands and to integrate these with objectives for surrounding lands. National as well as specific local guidance is needed.

More information about physical, biological, and social components of park and wilderness ecosystems is needed on both sides of political boundaries.

Key indicators of ecosystem condition are needed, and methods for evaluating management effectiveness must be identified.

All of these common themes point to a need for more precise direction in management goal-setting and more accurate assessment of progress in the chosen direction. The report will be available without charge from either Jim Agee or Darryll Johnson at the NPS CPSU, College of Forest Resources (AR-10), University of Washington, Seattle, WA 98195. A book containing the theme presentations from the workshop will be available for purchase from University of Washington Press in mid-1988.

Agee is a Research Biologist at the NPS/CPSU, U/WA, Seattle.

that they had eaten baits. Another 6 (12%) had slightly elevated iodine levels and were classified as borderline status, while 13 (25%) had no blood iodine rise above that typical of the control population. Too few nontarget animals were sampled to allow concrete inferences to be drawn, but there was evidence from both field signs and trapping that baits also were eaten by fox, feral cats, opossums, shrews and probably crows. Although each of the thousand bait packages had been stamped with a message identifying the contents and the purpose of the test, and giving a phone number to call for further information, no inquiries were received from the public. Perhaps the baits looked so much like other refuse that they were merely passed over by trash weary urbanites.

The study determined the feasibility of an oral baiting program to immunize raccoons in an urban national park. Feasibility is only one of many factors that must be taken into account in considering such a program, however. Still to be addressed are questions concerning the need and advisability of population immunization, the role rabies is playing as a natural process, the extent of responsibility by the NPS for visitor safety, and the extension of that responsibility in an urban setting to neighbors and others. There is little doubt that NPS will continue to play a role in regional planning to eradicate rabies from the Eastern United States, since national parks will be claimed to be reservoirs for the disease.

Control Issues Remain

Many issues remain to be considered in the complex interrelationship of administrative, managerial and scientific concerns related to rabies control. The 1986 oral bait acceptance study in Rock Creek addressed only logistical and practical concerns, and indicated the technical means necessary to accomplish the job of oral immunization if it were indicated as a needed program. Otherwise, the study allowed for testing of oral baiting technology itself, in a somewhat new and different arena. Oral baiting will no doubt be increasingly used in the future as a tool in wildlife population management.

Oral baits could potentially carry vaccines against virtually any wildlife disease. They could also be used to deliver chemosterilants to control reproduction in certain populations, biomarkers for population studies, even vitamins if so desired. The list of applications will grow as technologies in related fields expand and further knowledge is acquired on how to target and reach specific populations, and perhaps even specific segments of individual populations. Clearly a significantly developing management tool, oral baiting technology promises to be of special value to the wildlife managers of our National Parks.

Hadidian is the Urban Wildlife Biologist at the NPS, National Capital Region, Center for Urban Ecology.

Signals Switched!

In the Fall 1987 issue we promised "A Systematic, Comprehensive Approach To Resource Management of Caribbean National Parks" by Ro Wauer of the NPS Cooperative Extension Service at the University of the Virgin Islands, St. Croix. A call from Ro just before press time informs us that the plan has undergone extensive changes, necessitating a delay in the article until the Spring 1988 issue of *Park Science*. The changes, he says, are associated with action.

geographic information

DOI GIS Peripherals Contract

The Department of Interior contracts for GIS peripherals that I mentioned in the last issue of *Park Science* are now in place. Here are details on what's available and instructions on how to order:

1. Pericom MX7100 low resolution color terminal (640 x 480). DOI contract no.: YA-551-CT7-440018. Price: \$1795. Maintenance: \$10/mo. Options: none at this time. One year warranty.
2. Pericom MX10000 medium resolution color terminal (1024 x 768). DOI contract no.: YA-551-CT7-440018. Price: \$3795. Maintenance: \$15/mo. Options: none at this time. One year warranty.
3. Tektronix high resolution color terminal (1280 x 1024). DOI contract no.: YA-551-CT7-440023. Price: \$17,000 (FY88), \$13,000 (FY89), \$12,000 (FY90), \$11,000 (FY91). Maintenance: \$81/mo. (FY89), \$83/mo. (FY90), \$87/mo. (FY91). Options: additional memory and color planes, but not from the contract; contact Tektronix for details. One year warranty.
4. Xerox 4020 low resolution color screen copier (120 dots per inch). This is an ink-jet plotter. DOI contract no.: YA-551-CT7-440018. Price: \$925. Maintenance: \$10/mo. Options: none. One year warranty.
5. Tektronix 4696 low resolution color screen copier (120 dots per inch). This is an ink-jet plotter. DOI contract no.: YA-551-CT7-440023. Price: \$1045. Maintenance: \$15/mo. (FY89), \$16/mo. (FY90-91). Options: none. One year warranty.
6. Tektronix 4693D high resolution color screen copier (300 dots per inch). This is a thermal wax plotter. DOI contract no.: YA-551-CT7-440023. Price: \$6107. Maintenance: \$72/mo. (FY89), \$75/mo. (FY90), \$78/mo. (FY91), \$81/mo. (FY92). Options: additional memory, but not from the contract; contact Tektronix for details. One year warranty.
7. Pericom rasterizer. For use with Pericom MX7100 terminal and Xerox 4020 color screen copier. DOI contract no.: YA-551-CT7-440018. Price: \$1297. Maintenance: \$10/mo. Options: none. One year warranty.
8. Tektronix 4510A rasterizer. For use with any of the terminals and screen copiers. DOI contract no.: YA-551-CT7-440018. Price: \$3953. Maintenance: \$71/mo. (FY89), \$81/mo. (FY90-91), \$90/mo. (FY92). Options: addition memory, but not from the contract; contact Tektronix for details. One year warranty.
10. CalComp 1042GT pen plotter. Eight pens, continuous or cut sheet modes, 34.6 in. width. DOI contract no.: YA-551-CT7-440017. Price: \$5445. Ninety-day warranty. Maintenance: \$25-46/mo., depending on distance from a CalComp service center. Specify Hewlett Packard ROM pack (instead of the standard CalComp ROM pack) and RS232 interface. Purchase additional supplies: pens, ink, paper, transparencies, grit drum. Obtain a copy of the Graphic Supplies catalog for 1040GT Pen Plotters from CalComp (1-800-CALCOMP) for specifics, including prices.
11. Altek digitizers (three sizes, two styles in each size). DOI contract no.: YA-551-CT7-440016. Prices: C-size (24 x 36 in. active surface), non-backlit: \$3837; C-size, backlit: \$4281; A-size (36 x 48 in. active surface), non-backlit: \$4203; A-size, backlit: \$5421; B-size (42 x 60 in. active surface), non-backlit: \$4653; B-size, backlit: \$6318. Specify 5-mil accuracy, 16-button cursor, option AC40-F1 (scaling and scale translation), and option AC40-F2 (variable formatting). Recommended options: AC40-KP (40-key touchpad; \$140), AC40-D (32-character LCD; \$210). 3-mil accu-

racy, battery backup, temporary parameter storage, and continuously variable-intensity lighting also available as extra cost options. One year warranty. Maintenance: C- and A-size non-backlit: \$40/mo., backlit: \$50/mo.; B-size, non-backlit: \$45/mo., backlit: \$55/mo. *Shipping not included* (estimate \$300). Includes a power base for mounting the tablet.

If you are anticipating using SAGIS for your GIS processing, you should purchase these items, which are all compatible with the SAGIS family of GIS software. By some time this winter we hope also to have them running with GRASS. Follow these steps to place orders:

1. Complete NPS-62, your ADP requirements analysis.
2. Prepare your requisitions for the desired equipment.
3. Send the requisitions and the approved requirements analysis to your procurement officer, who prepares the appropriate purchase orders, one for each vendor. Be sure to cite the relevant DOI contract number.
4. Send the approved requirements analysis and signed purchase order to John Thomas, Branch of Procurement, M.S. 236, WASO. John will forward them to the BLM, who is administering the contracts, for filling of the orders.

Note that these contracts will be in place for five years. As technology changes, new items and upgrades will be added to them. Be sure to give me a call before ordering to see what the latest changes are (FTS 327-2590, 303-969-2590).

One final note on this topic: we intend to have a SAGIS/GRASS training session in Denver in February (see accompanying item). This would be a good time to get hands-on training in the use of this equipment, particularly if you are considering purchase and want to better understand the equipment and its capabilities. Call me to register your interest.

Harvey Fleet, Chief
Digital Cartography Branch
GIS Division, NPS Denver

Status Update: Hardware and Software

SAGIS: The UNIX version of SAGIS is now operational and running on both the OPUS Systems UNIX PC add-on board and the Masscomp workstation. Only a handful of modules remain to be converted to the UNIX environment; their absence is not expected to interfere with immediate production needs. They should become available over the next six months.

GRASS: We anticipate having GRASS up on the UNIX board by Jan. 1. We have written converters to move raster files between SAGIS and GRASS. Moving vector files from SAGIS to GRASS is a more dif-

At Last! An Updated Directory Of Natural Resources Personnel

You've been asking for it . . . you've been begging for it, and now at last, you're going to get it! An updated Natural Resources Personnel Directory is in the final stages of creation and will be available in hard copy and through the NPS COMMON database by the first of 1988.

Major-domoing this long-awaited working tool is Anne Frondorf, NPS Natural Resources Program Analyst, who assures us that the new directory will allow search and retrieval by name, by park, by area of expertise,

and also by job title. This means you can finally ditch that old 1980 yellow copy that's so scratched out, written over, erased, and generally tortured that you can barely find anything or anyone anymore.

SAGIS/GRASS Training Slated

The GIS Division will hold a SAGIS/GRASS training session in Denver Feb. 1-5, 1988. The course will be a hands-on training session in the use of SAGIS/GRASS software and hardware in the OPUS Systems UNIX environment. Masscomp workstations may also be utilized if interest and arrangements permit.

The course will cost \$100 and will run from noon Monday to noon Friday, with several evening sessions. While the course is designed for users who have, or nearly have systems up and operating, those who merely wish to learn about the subject may attend as space permits.

There will be a minimum of 16 stations and a maximum of three students per section. Each station will consist of a graphics terminal driven by a UNIX processor, possibly including Bernoulli drives. Opportunities also will be provided for using digitizing tablets and plotters, to approximate as closely as possible the environment used by the students at their home sites.

Status Update: GIS Capabilities and Data Bases

List 1. Parks with GIS data bases ready for use: Acadia, Big South Fork, Big Thicket, Big Bend, Cape Cod, Capitol Reef, Death Valley, Denali, Everglades, Glacier, Great Smoky Mountains, Lake Mead, Minute Man, Morristown NHP, Mount Rainier, North Cascades, Obed, Olympic, Prince William, Redwood, Santa Monica Mountains, Saratoga, Shenandoah, Wrangells/St. Elias, Yellowstone, Yosemite.

List 2. Parks with GIS data bases under construction: Antietam, Big Cypress, Richmond.

List 3. Parks and related units with *onsite* operational GIS capabilities (i.e., hardware and staff in hand to conduct onsite, stand-alone GIS activities; this list excludes parks with strictly CAD or display capabilities): Biscayne, Obed, Shenandoah, Yosemite.

List 4. Parks and related units *in the process* of acquiring operational onsite GIS capabilities: Big Cypress, Big South Fork, Bryce Canyon, Canyonlands, Capitol Reef, Everglades, George Washington Memorial Parkway, Glen Canyon, Gulf Islands, Indiana Dunes, Mount Rainier, Richmond, Santa Monica Mountains, Southeast Archeological Center.

Remember, if you're not on one of these lists – and you feel you should be – or you're not on the right list, or your situation is just plain misrepresented, drop me a note or simply call (FTS 327-2593, 303-969-2593) to correct matters. Also, don't forget the open invitation to send in comments and articles about your GIS activities.

Hard copies will be distributed to all science and natural resources staff in Washington, D.C., and at parks, regional offices, and the CPSUs. All praises be to the new science and natural resource publication program under whose aegis the directory is coming out!

Improving the Role of Science in the National Park Service

By Jim Wood
Technical Publications Writer/Editor

Throughout the U.S. National Park Service, scientists and resource managers are becoming increasingly concerned about the relationship of science to the management decision-making process. What is the proper role of science within that relationship? How can it be improved to meet the park management challenges of the decades ahead, to the year 2000 and beyond?

The history of science in the National Park Service has been marked by questions concerning its effectiveness and usefulness to park management. Over the years, many park managers have said, "The Service's science and research programs are not meeting our management needs." And they're still saying it today.

If history were our teacher, she would ask us, "Why is it so easy to criticize and to identify deficiencies in a program, yet so difficult to change or restructure it to eliminate the deficiencies and truly increase its effectiveness?"

Research in the National Park Service has been accomplished in various ways over the years, with mixed results as viewed by management. One prevailing criticism is that too often the programs have been reactive rather than proactive. While this is true to a certain extent, I believe reactive management is often unavoidable in many cases. Then, too, I am skeptical about the proliferation of committees and task forces that are supposed to come up with panaceas that will lead us toward the promised land. Such exercises – when used sparingly and when conducted with a goal of rational change – are beneficial, but only up to a point.

If I want to be a good basketball player, I need to be well-versed in the fundamentals of the game – and I must apply these fundamentals to master my athletic skills through daily practice and game experience. If my teammates and I want to win games – certainly we want a good coach. Good basketball coaches know that if their teams fall short in fundamentals, talent, or experience – no amount of "brilliant pre-game strategy" will consistently win future games.

So, too, it is with science and research. Successful research organizations are led by competent and experienced research administrators who know there are no shortcuts to success. They have proven research records. They have earned the respect of their colleagues in the scientific community. They know the fundamentals of good science. They know how to apply the scientific method, they know how to judge, recruit and lead capable scientists, and they are themselves scientists who have learned from their own past research experiences. They also know how to match the available skills of their research staffs to research needs and plan and adjust their programs accordingly. The result? Scientific information that is straight and unbiased, albeit not always what management might want to hear.

The point is that committees and task forces may be useful, but too often they lead to superficial understanding and broad recommendations that are hard to translate into specific actions. And all too often they continue to overlook the basics, the real problems.

Let's face it. Our National Park Service science and research program remains fundamentally fragmented,

hasn't built upon the lessons of past experiences, and has no coherent sense of direction, unity, and purpose.

Instead of beating around the bush and relying on still more "band aid" approaches, we need surgery. We need to establish a solid foundation for our science program. We can begin by first looking back at what we have done in the past and noting the successes. Several of these include:

- The development and use of Cooperative Park Studies Units . . . an extremely successful means of acquiring scientific research, the units have fostered close working relationships with university experts and have resulted in the effective use of time and money. Some coordination is needed, however, and proper management, operation and staffing is critical.

- The development of regional interagency and interinstitutional "clustered research" groups, both in the parks and at universities, to respond to multiple park needs. The Southern Appalachian Research and Resource Management Cooperative (SARRMC), for example, has proven contributed research funds and tools needed for success.

- The development of a few national, in-house scientific research units with generic responsibility to support multiple park, regional, and Servicewide research needs. Examples include the Water Resources Field Support Laboratory (now the Applied Research Branch of the Water Resources Division) at Colorado State University and the archeological research centers, where efficiencies and capabilities are achieved through a single support group.

- The development of regional-based science funds – i.e., the "cyclic science program." These funds support park-specific research projects that meet regional priority needs.

Despite these successes, much still remains to be done. During the recent Conference on Science in the National Parks (held on July 13-18, 1986 at Colorado State University, Fort Collins, Colorado), numerous approaches were suggested for restructuring the NPS organization to improve and optimize the scientific basis of resource management in the parks. The recommendations of the speakers and the panel and symposium discussions suggest a three-part process for developing an appropriate, responsive, well-directed and well-managed science program:

- First, deal theoretically with the role that research can and should play in the NPS administrative and management process;

- Second, reiterate the values of quality research, properly organized (vis-a-vis the natural, social and cultural sciences) to park management; and

- Third, implement a research structure that will fit within the management system of the National Park Service to directly recognize, utilize and support research.

It was also emphasized that any attempt to restructure the NPS science organization should be mindful of the following basic principles:

- Research does not make NPS policy, but it can provide the information base for policy formation.

- Research cannot (and should not) manage. But it can support or not support management decisions (in either case, the research information must be provided in an objective, unbiased fashion).

- Research cannot remain unbiased when it is managed by management or otherwise incorporated

too closely into the management structure.

At this point, four structural issues are identified as important: (1) who is responsible for research, (2) the relationship between research and resource management, (3) the nature and structure of resource management, and (4) the roles of the two functions (research and resource management) at the national, regional and park levels.

First, research must be responsible to research. In other words, principal investigators and field researchers must be responsible to a research organization – not a management organization. This is absolutely essential for continued scientific project and program support, review, and evaluation (this has been reiterated at all levels of government and holds true in the NPS). As the researcher must be held accountable for project success, so, too, the research administrator must be held accountable for program success. And this accountability, all up and down throughout the research organization, must be based on the principles of sound, ethical, unbiased science. Thus, research responds to two masters: peer review (for quality scientific products) and management review (the research program must meet NPS needs, both short- and long-term). In short, the NPS must have a responsible and technically qualified research administration. The research administrator is then responsible to NPS management at the appropriate level for structuring a research program that meets management informational needs. Research is not a line function of management and this relationship (separation of responsibilities) should not be distorted or forgotten.

Second, it is again stressed that research and resource management are separate and distinct functions. Trying to convince ourselves otherwise leads to problems. The cold, hard truth is: the fundamental purpose of research is to provide management with objective, unbiased scientific information. The fundamental purpose of resource management is to implement field operations that "... conserve the scenery and the natural and historic objects and the wildlife ... in such manner and by such means as to leave them unimpaired for the enjoyment of future generations," based on adequate scientific knowledge and application of appropriate techniques. The fact that these two functions are inherently separate and distinct, however, does not mean that researchers and resource managers should not talk to each other or work together. What it means is: research should develop information, evaluate information, and provide expert scientific (not managerial) consultation to both planning and operations. Resource management is a line activity that acts on the scientific information supplied. It follows, then, that both organizations must be professionally and technically able and there will be some overlap and some conflict. This is not necessarily bad; but it can, and should, be minimized by clearly defined and agreed-to organizational responsibilities. (While one person can theoretically do both jobs, such an expectation often creates an impossible personal dilemma [viz, the need to meet the requirements of the Research Grade Evaluation process] and should be avoided. The present tendency to combine these two functions has caused much confusion and has disrupted both research and resource management activities.)

Third, resource management – as a line function – should be structured, staffed, and funded to ensure

the operational capability to deal with resource issues. The role of research is one of assistance and can be either active or passive. The importance of capable research support is not diminished, however.

Fourth, any redefinition of organizational roles will always be risky, as "someone's turf will probably be stepped upon." Nevertheless, an improved research structure can be implemented within the existing NPS management structure with minimal disruption or change. How? By establishing:

1. Clear and definitive role and function statements;
2. A clear statement of policy on research. Under present conditions, it might be helpful to select a group of senior NPS scientists to work with top NPS management and the Director's Blue Ribbon Panel to set long-term goals and objectives;
3. A clear-cut separation of research from other management activities, including control of research budgets (but not without accountability to management);
4. A strengthening of the base funding for research (effective research cannot be accomplished with uncertain year-to-year funding);
5. Infusion of professional science personnel standards for all researchers (Research Grade Evaluation) and research administrators (Research Administration or Grants Evaluation) and enforce them;
6. Direct, functional ties between research levels (WASO, Regional Offices, CPSUs, parks, etc.) to ensure proper direction and evaluation from a centralized science program management standpoint; and
7. The return of the Chief Scientist (or equivalent) position in the Washington, D.C. office. This position should consist of a technically qualified, professional scientist/research administrator with a knowledge of the NPS.

Summary: Historically, the relationship between science and resource management in the NPS has always been a difficult one. The crux of the difficulty seems to be management's failure to fully understand the basic purpose of research and its need to be properly structured and supervised. By its nature research is a quality control function. Sooner or later the results of research will be critical of the status quo with regard to park management. Park managers are not professionally trained individuals when it comes to supervising science. They basically do not understand the modus operandi of a true researcher nor should they be expected to have such understanding. They certainly cannot be expected to constructively outline, let alone supervise the execution of, a research program. Yet over the years the Park Service has expected this of many. This is a unique organization of science research within a unique land management agency, and I know of no other such attempt in other government agencies or in the private sector.

The result has been little relative evolution of the quality or quantity of scientific research in the national parks since the adoption of the Leopold Report in 1963. This has been aggravated by the NPS management – leadership's perception of how science can be run in the organization. There are still many who think it can be done at a decentralized, local level. Our application of the Research Grade Evaluation Process has proved this will not work.

But all is not lost; we can, and must, do better. If we recognize the common sense reality of the need to examine the *basics* – as suggested in this article – we may be able to give ourselves an excellent chance to lay the foundation for a professional, responsive and competent science program for the National Park Service. Such a program will never attain

Long-term Research Symposium Summary

Significance of long-term ecological research in preserving national parks. R. Stottlmyer, organizer. Symposium held at 72nd National Meeting of the Ecological Society of America (ESA), Columbus, OH, Aug. 9-14, 1987.

The goal of this symposium was to acquaint and encourage the ESA community to see the research potential, public service value, and professional satisfaction possible from the conduct of long-term research in national parks. Symposium objectives were 1) to demonstrate the unique opportunities parks have in the conduct of long-term ecological research; 2) to demonstrate the need to carry out long-term research to meet mandated obligations of ecosystem preservation; 3) to provide examples of where long-term ecological research in parks has led to change in park management and public land use policy, and 4) to explore possibilities for use of Park Service interpretive programs to further public knowledge of ecological research and its role in preserving our natural heritage.

The speakers and topics addressed were: Dr. Rolf Peterson, Mich. Tech U., "The wolves of Isle Royale: 30 years of evolution in understanding;" Dr. Lloyd Loope, Haleakala NP, "The role of long-term research and monitoring in managing biological invasions in national parks of Hawaii;" Drs. William Halvorson and Gary Davis, Channel Islands NP, "Long-term natural resources monitoring in Channel Islands National Park;" Dr. James Kushlan, East Tex. State U., "The Everglades, developing ecosystem management goals based on long-term research;" Dr. Robert Dolan, University of Virginia, "Management of coastal and marine areas within the National Park System;" and Dr. Robert Stottlmyer, "Long-term watershed ecosystem research in national parks." Additional input on long-term fauna/flora research was provided by Dr. Donald Despain, Yellowstone NP.

The predator-prey studies on Isle Royale, conducted by Dr. Peterson, serve to demonstrate the need for long-term research to obtain a proper understanding of the true length of natural population cycles. The interpretation of these research results has shifted considerably over the years as new data became available, and it is clear the early interpretations were in error due to the lack of knowledge involving the length of natural cycles and factors limiting population size at various stages in the cycle.

The primary factor in the success of long-term research is commitment of the principal investigator

perfection – it certainly won't be without its problems and conflicts – but it will increase our opportunities to produce scientific products of better quality, objectivity and credibility. After all, we do need improved resource understanding, management and interpretation ... don't we?

The lame in the path outstrip the swift who wander from it.

– Francis Bacon

Acknowledgments

I would like to thank Dr. Raymond Herrmann, National Park Service Water Resources Division, Colorado State University, Fort Collins, and Dr. Robert Stottlmyer, Great Lakes Area Resources Studies Unit, Michigan Technological University, Houghton, Michigan, for many of the concepts of science program management expressed in this article. I also wish to thank R. Linn, G. Larson, S. Coleman, J. Ogle, F. Noe, P. White, S. Moore, and R. Dawson for their critical reviews and comments.

(Strayer et al. 1986). The research on Isle Royale and the work of Dr. William Robertson at Everglades are among the best examples of this commitment, against many odds, within the National Park System.

Islands are especially vulnerable to biological invasions, and much long-term research has focused on such ecosystems. Dr. Loope addressed this question for Haleakala and Hawaii Volcanos NPs. While these parks are some of the most intact areas of the Hawaiian Islands, still about half their species are introduced. The most damaging have appeared to be alien (exotic) ungulates. The long-term study of their invasion has also demonstrated how long the adverse influence of alien herbivores can last in an ecosystem. Now additional research is underway examining how alien invertebrates and plants are exerting influence. There remain many local examples of intact ecosystems at high elevations or on specialized substrates, and monitoring should be put into place to quantify both endemic and alien biota responses to change in introduced exotic populations.

The history of research in Everglades NP, addressed by Dr. Kushlan, and the emerging databases developed in selected parks for assessing ecosystem response to atmospheric contaminants point out the need for understanding fundamental ecological processes that drive park ecosystems. Such studies can provide quantitative management goals. These goals, in turn, can provide strategies and performance standards for research and monitoring. Acceptance of such standards, however, usually requires the heavy involvement of scientists external to the Park Service. Process-oriented research is the minimum necessary to carry out the mandates of public resource managing bureaus, but its sophistication and complexity will require a fundamental shift in NPS research strategy and training of personnel.

The Channel Islands research program also focuses on the dynamics of endemic vegetation species subjected to severe grazing pressure. Here also are examples of endemic plant species surviving in local refugia, and now recovering with removal of the exotic herbivore. Dr. Halvorson also outlined the Channel Islands ecosystem monitoring program, which goes far beyond just the monitoring of alien species impact. It is perhaps the most elaborate attempt in the entire NP System to provide a context within which change in individual species or abiotic factors may be followed.

Perhaps no better example exists to demonstrate the significance of systematic long-term, process-oriented, ecosystem-level research than the effect such research has had on barrier island management. Research conducted by Dr. Dolan and Dr. Paul Godfrey (U/Mass) among others, funded in large part by NPS, profoundly changed the management goal of these intrinsically dynamic systems. Further, this research served as a basis for the 1982 Coastal Barrier Island Protection Act, which eliminated many of the federal incentives for the development of private barrier islands. This legislation has the potential to enhance the protection of existing barrier island reserves and to save the U.S. billions of dollars a year. Providing a sound principled basis for national environmental policy is the ultimate service a bureau such as the Park Service can perform.

In a quick review of audience response, the main concern related to the sincerity of the Park Service in pursuing long-term research. For example, there is no research strategy in place for the NP System or, for that matter, for most parks. A symptom of this is no

Long-term Research

Continued from page 23

Request for Proposals relating to such research. Also, there is the near absence of funding for research/resource management, the least for any national resource managing bureau. Also there is the paucity of peer review of much NPS research. All of these suggest a lack of interest in involving the external scientific community.

The potential for national parks to play a larger role in long-term research, involving both external personnel and funding, has been adequately demonstrated in undertakings such as at Sequoia-Kings Canyon NPs. But even this type of cooperation requires steady Park Service funding in amounts far above that traditionally spent on research or monitoring. Also it requires program review by persons reasonably current in their respective disciplines. Nationally, there are fewer than 65 NPS employees on Research Grade Evaluation – hardly the base for program peer review of internally or externally-funded research.

Long-term research/monitoring requires a commitment from both the researcher and the funding agency. Steady funding, principally for baseline inventory and monitoring, is the primary obligation of the funding agency. Long-term study is by its nature complex, and it requires a multi-disciplinary research approach. The number of researchers within Park Service and their array of expertise is not at the threshold for an effective effort. The need for considerably expanded external involvement is both apparent and feasible. It is time the Park Service outgrew its intimidation in dealings with the external scientific community.

Computer Corner will appear in the Spring issue

Literature Cited:

Strayer, D., J.S. Glitzenstein, C.G. Jones, J. Kolasa, G.E. Likens, M.J. McDonnell, G.G. Parker, and S.T. Pickett. 1986. *Long-term ecological studies: an illustrated account of their design, operation, and importance to ecology. Occasional Pub. #2, Institute of Ecosystem Studies, New York Botanical Garden, Millbrook, N.Y., 38 p.*

Robert Stottlemeyer, *Research Scientist*
NPS Great Lakes Area Research Study Unit
Michigan Tech University

Research Summaries To Come

Robert Stottlemeyer has promised for the Spring 1988 issue of *Park Science* summaries of the work done at Glacier Bay, Lake Clark, and Denali NPS sites. The research consists of baseline characterization of surface water chemistry – soil and stream water – and eventually will cover most of the Alaskan NPs. On tap for the next two years are Gates of the Arctic, Noatak, Katmai, and Wrangell-St. Elias.

WILLIAM PENN MOTT, JR., Director
National Park Service
U.S. Department of the Interior

Editorial Board:

Gary E. Davis, Marine Research Scientist, Channel Islands NP
John Dennis, Biologist, Washington Office
James W. Larson, Editorial Board Chairman and Chief Scientist, Pacific Northwest Region
Roland H. Wauer, NPS Cooperative Extension Service, College of the Virgin Islands, St. Croix, USVI
Harvey Fleet, Chief, Digital Cartography, GIS Division, Denver

Jean Matthews, Editor: Oregon State University NPS/CPSU, Room 150 Forestry Sciences Lab,
3200 Jefferson Way, Corvallis, OR 97331 (503) 757-4579; 8-420-4579

ISSN-0735-9462

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT 417

